

~~Q1~~
~~VSX~~
~~NH~~

Q1
VSX
NH

THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE

Vol. 14. New Series

January, 1963

No. 1





VOL. 14, NEW SERIES

No. 1

JANUARY, 1963

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND
SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

Printed by *The Bassett Printing Corporation*, Bassett, Virginia

CONTENTS

	<i>Pages</i>
Summer Programs Provide Science Study Opportunities for Virginia's High School Students. A. Mandell	1
A Spectrophotometric Investigation of Iodine Trichloride in Carbon Tetrachloride. R. D. Whitaker and G. B. Fozzard	6
Some New and Unusual Fungi from Virginia. I. Lower Phycomycetes. W. W. Scott, R. Seymour and C. Warren	11
A Redescription of the Hymenostome Ciliate <i>Sathrophilus</i> (<i>Saprophilus</i>) <i>muscorum</i> (Kahl, 1931) Corliss, 1960, with Particular Attention to the Buccal Apparatus. J. C. Thompson and Margaret V. Cone	16
News and Notes	23

EDITORIAL BOARD

Paul B. Siegel, *Editor*

Carl W. Allen, *Managing Editor*

SECTION EDITORS

W. P. Anslow, Jr.	C. Y. Kramer	W. T. Parrott
D. R. Carpenter, Jr.	A. Mandell	F. B. Rowe
P. A. Hansen	N. F. Murphy	G. W. Thomas
M. A. Kise		J. C. Thompson

Entered as second-class matter, at the post-office at Bassett, Virginia, and Blacksburg, Virginia, under the Act of March 3, 1897. Subscription \$3.00 annually. Published four times a year: in January, April, July and September by the Virginia Academy of Science at Blacksburg, Virginia.

Mailed December 29, 1962

PRESENTED BY THE
ALDERMAN LIBRARY
UNIVERSITY OF VIRGINIA
ON EXCHANGE ACCOUNT

THE VIRGINIA JOURNAL OF SCIENCE

VOL. 14, NEW SERIES

JANUARY, 1963

No. 1

SUMMER PROGRAMS PROVIDE SCIENCE STUDY OPPORTUNITIES FOR VIRGINIA'S HIGH SCHOOL STUDENTS

Several programs of interest to science teachers were initiated during the summer of 1962. Opportunity was provided for high school students to participate in advanced study of Earth Sciences, Chemistry, Marine Biology, Oceanography, and Nuclear Physics. Cooperation between the Federal Government, state colleges and universities, local scientific industries, and high school teachers made the program possible. Three of these programs are described below.

UNIVERSITY OF VIRGINIA-FAIRFAX COUNTY COOPERATIVE INSTITUTE

Through a grant from the National Science Foundation to the University of Virginia, and with the cooperation of local research and development laboratories, an eight weeks program of intensive scientific study in two fields was presented to 47 students, most of whom were commuting to its site, Fairfax High School.

Earth Science had 23 students representing not only Northern Virginia, but Giles County, Virginia; Winston-Salem, North Carolina; and Neavitt, Maryland. Their studies led them into the fields of geology, meteorology, oceanography, and astronomy. Their chief lecturer was Dr. William B. Brent. Two Fairfax County teachers, Mr. Louise Banks of Fairfax High and Mrs. Bernice Donaldson of McLean High, were teacher co-participants.

In the chemistry division, there were 24 students with one from Philadelphia and others beyond commuting distance from Virginia including Danville, Portsmouth, and Pearisburg. Dr. William Parrish of Virginia Episcopal School in Lynchburg, and Mrs. Edna Luck of North Miami High in Florida were teacher co-participants. Mr. Hyman Feinstein of George Mason College acted as principal lecturer. Laboratory experiments in radioisotope tracer techniques, instrumentation versus wet lab

traditional methods, and organic synthesis provided challenging opportunities to introduce the student to research training.

Both divisions provided field trips in direct connection with their studies. The highlight of this activity for the earth science class was a three day tour of some of the geological resources and industries of Virginia. In chemistry, the industrial vastness of Bethlehem's Sparrow's Point, Maryland, steel plant competed with the research laboratories of nearby governmental agencies for student interest.

Guest lecturers from government and industry sparked enthusiasm with types ranging from fundamental to far-out thinking.

Since the chief purpose of the program was to motivate and challenge, the culminating activity is to follow during the 1962-63 school year with follow-up research and paper presentations at the annual meeting in May of the VJAS in Roanoke.

With Dr. Bart van't Riet of the University of Virginia's chemistry department acting as the director for the past two summers, the University looks forward to an expansion into a third discipline, biology, in 1963, with physics and mathematics programs as additional offerings in 1964.

All, of course, is dependent on the continued cooperation of NSF, University of Virginia, the Fairfax County School Board, and local organizations. Brochures describing the future activities will be sent out in early January.

Morris S. Tischler, *Institute Coordinator*,
G. C. Marshall High School,
Falls Church, Virginia.

UNIVERSITY OF VIRGINIA-ROANOKE CITY SCHOOLS SUMMER INSTITUTE PROGRAM

Under a National Science Foundation grant awarded to the Research Laboratories of the Engineering Sciences, University of Virginia, and the Roanoke City Public Schools, a summer institute program for academically talented eleventh grade students was initiated this summer. The eight-week program was offered in the disciplines of Nuclear Physics and Nuclear Engineering at William Fleming High School. Participating students, selected primarily from southwest Virginia at large, are now beginning their regular high school physics program as seniors.

Basically the summer program was oriented toward using the laboratory as a focal point—a place of discovery where the student could question and pursue solution through laboratory investigation. Thus the laboratory was the fundamental instrument of instruction, not simply an agent

for the verification of previously learned ideas. In keeping with this philosophy that the root of the discipline of science lies in its applicability as a mode of inquiry (not simply a body of fact) student acquisition of new knowledge was derived from careful analysis of laboratory data. In general, the program involved staff and guest lecturers, field trips, and extended laboratory periods using a problem-solving approach.

A central objective of the summer program was to provide sufficient background and stimulation to encourage the students to develop individual research projects in which they are now engaged this academic year. The University staff, as well as participating teachers, are available to the participants for counsel and advice at any time. At least one visit will be made to each Virginia student during the year. In the spring of 1963, the students will gather for a one-day meeting at which they will present formally the results of their year's work. The following are examples of research problems which arose from the summer institute and on which the students are at this time working.

1. Detailed study of particle scattering using mechanical analogies
2. Shielding and build-up of gammas
3. Effect of radiation on plant life
4. Body oxygen content as a factor of radiation damage.

The results have been most gratifying. Based on experience to date, application is being made for a repetition of the program in the summer of 1963. Further plans are being submitted for extending the program to include other disciplines to the end that effective research-oriented program can be a regular offering to the able student.

These plans include modifications resulting from the experience of last year's programs. For example:

1. Increased participation by the high school teacher
2. Increased number of areas of experimentation for student research oriented study
3. Half-time services of a qualified University of Virginia professor to be made available to participants in such programs for the full academic year
4. Development and manufacture of additional laboratory apparatus permitting the study of nuclear phenomenon using mechanical analogies.

It is our feeling that these National Science Foundation programs for the able students are of great value and somewhat untapped potential.

This potential can be realized if our Virginia science teachers will support the programs, encourage qualified students to apply, develop such programs in their own areas, and work with the student upon his return. The rewards in this area are most gratifying.

Dr. Davis Redfield, *Science Supervisor*,
Roanoke City Public Schools

VIRGINIA INSTITUTE OF MARINE SCIENCE-NORFOLK CITY SUMMER INSTITUTE

The oceanography project was an endeavor to provide opportunity for further study in the general field of oceanography to academically talented senior high students. Fifteen students from the Norfolk area participated in the program this past summer.

The program was organized to provide an hour and a half per day for guest lecturers, and time each day for field trips. The last three weeks of the eight week session were allocated entirely to individual research. Students began, during this period, research projects which are expected to continue during the school year. Some of the topics selected for investigation are listed below.

1. Observations of *Artemia*.
2. A Physiological Study of the Blue Crab.
3. Chemical Analysis of the Bay Water Surrounding the Chemical Fertilizer Plant.
4. An Introduction to the Historical Geology of the Virginia Coastal Area.
5. Research Investigation in *Dactylometra quinkuecirrha* and *Aurelia aurita*.
6. Marine Worms: An Ecological Study.

During the final week of the program each student reported his progress in research to the group.

The field trips made included the Seashore State Park, the Rice Fossil Pit in Hampton, a day aboard the oceanographic vessel, *Langley*, and the Marine Institute at Gloucester. Dr. William J. Hargis, Director of the Institute, aided in the preparation of field trips and in the provision of guest lecturers.

Because of the enthusiasm generated among the students, the Norfolk

City school personnel, and the local scientific community, by this first program, it will be continued and expanded.

R. F. Kelly, *Supervisor of Curriculum Materials*,
Norfolk City

SUMMARY

All persons associated with these summer science programs have expressed enthusiasm regarding their value. Each of the programs described is expected to continue and to expand. Persons wishing more information regarding these programs or assistance in establishing similar programs in other communities are urged to write the directors of the Institutes described above.

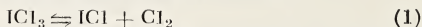
Alan Mandell, *Section Editor*

A SPECTROPHOTOMETRIC INVESTIGATION OF IODINE TRICHLORIDE IN CARBON TETRACHLORIDE ¹

Robert D. Whitaker² and George B. Fozzard
Washington and Lee University
Lexington, Virginia

(Received for publication May 24, 1962)

It has been noted (Rochow and Kukin, 1952) that solutions of iodine trichloride in carbon tetrachloride consist of a mixture of iodine trichloride, iodine monochloride, and chlorine due to the equilibrium:



The spectrum of these solutions shows a maximum absorbance at 460 $m\mu$ and a smaller maximum at about 335 $m\mu$. These wave lengths correspond to the absorption maxima for iodine monochloride and chlorine, respectively. Unless iodine trichloride solutions are kept in tightly stoppered containers, the maximum at 335 $m\mu$ disappears rapidly with time, and the maximum at 460 $m\mu$ decreases slightly with time. The other interhalogen compounds of iodine have spectra which show a single maximum in the visible and near ultraviolet region.

The present study was undertaken to obtain data which would allow the calculation of the equilibrium constant for (1). With quantitative information concerning this equilibrium, the absorption curve for iodine trichloride alone could be constructed and the influence of the equilibrium on the observed spectrum of solutions of this compound determined.

EXPERIMENTAL PART

Chemicals. Iodine Trichloride was prepared by standard methods (Booth and Morris, 1939). It was found that iodine trichloride can be kept for long periods of time in a state of high purity when it is stored under a chlorine atmosphere at 10° or less. Spectro-grade carbon tetrachloride, obtained from the Eastman Kodak Co., was used as the solvent.

¹This paper is based on a thesis presented to Washington and Lee University by G. B. Fozzard in partial fulfillment of the requirements for the degree of B.S. in Chemistry. The results reported herein were presented before the Chemistry Section at the 1962 meeting of the Virginia Academy of Science.

²Present Address: Department of Chemistry, The University of South Florida, Tampa, Fla.

Spectra. The ultraviolet and visible spectra were determined with a Beckman Model DB Spectrophotometer. Matched, ground-glass-stoppered, silica absorption cells of 1 cm. thickness were used. Pure carbon tetrachloride served as the reference. The cell compartment was thermostatted at $25.0^\circ \pm 0.1^\circ$. Spectra were determined on the solutions as soon as possible after preparation and thereafter at intervals of several hours for a period of 24 hours or longer. A correction was applied to those absorbance values which decreased significantly with time by plotting the absorbance as a fraction of time and extrapolating to zero time. For a given series of measurements, the most concentrated solution was prepared by direct weighing and the other solutions prepared by quantitative dilution. The concentration range used in this study was $10^{-3} - 10^{-2}$ M. All solutions were stored in tightly-stoppered ground-glass, volumetric flasks, thermostatted at 25.0° .

RESULTS AND DISCUSSION

The absorption data were treated by a method (Rose and Drago, 1959) in which the only assumptions are conformity to Beer's Law by all species in solution and the existence of the single equilibrium expressed by equation (1). For quantitative purposes, a wave length of $460 \text{ m}\mu$ was used since the decrease of absorbance values with time was slight.

The concentration equilibrium constant for equation (1) may be expressed:

$$K = \frac{[\text{ICl}] [\text{Cl}_2]}{[\text{ICl}_3]} \quad (2)$$

where $[\text{ICl}]$, $[\text{Cl}_2]$, and $[\text{ICl}_3]$ represent the equilibrium molar concentrations of iodine monochloride, chlorine, and iodine trichloride, respectively. Since the solutions were prepared by dissolving known amounts of iodine trichloride, we may write:

$$[\text{ICl}] = [\text{Cl}_2] = [\text{ICl}_3]_0 - [\text{ICl}_3] \quad (3)$$

where $[\text{ICl}_3]_0$ represents the initial molar concentration of iodine trichloride. Combining equations (2) and (3):

$$K = \frac{([\text{ICl}_3]_0 - [\text{ICl}_3])^2}{[\text{ICl}_3]} \quad (4)$$

The absorbance, A , at a given wave length is:

$$A = a_{\text{ICl}_3} [\text{ICl}_3] + a_{\text{ICl}} [\text{ICl}] + a_{\text{Cl}_2} [\text{Cl}_2] \quad (5)$$

where the a 's represent the molar absorptivities of the indicated species at the appropriate wave length. At $460\text{ m}\mu$, $a_{\text{Cl}_2} \approx 0$, so that for the case at hand, equation (5) becomes:

$$A = a_{\text{ICl}_3} [\text{ICl}_3] + a_{\text{ICl}} [\text{ICl}] \quad (5a)$$

By the use of equation (3), (5a) may be written:

$$A = a_{\text{ICl}_3} [\text{ICl}_3] + a_{\text{ICl}} ([\text{ICl}_3]_0 - [\text{ICl}_3]) \quad (6)$$

If equation (6) is solved for $[\text{ICl}_3]$ and then substituted into equation (4) after expansion of the right hand side of equation (4), there results:

$$K = \frac{[\text{ICl}_3]_0^2 (a_{\text{ICl}_3} - a_{\text{ICl}})}{A - a_{\text{ICl}} [\text{ICl}_3]_0} - 2[\text{ICl}_3]_0 + \frac{A - a_{\text{ICl}} [\text{ICl}_3]_0}{a_{\text{ICl}_3} - a_{\text{ICl}}} \quad (7)$$

At $460\text{ m}\mu$, a_{ICl} has a value of 152 (Buckles and Mills, 1954), $[\text{ICl}_3]_0$ is known, and A is determined experimentally. There are two unknowns in equation (7), a_{ICl_3} and K . Equation (7) is a modified form of a

previously published equation (Rose and Drago, 1959) which was used to treat systems of a nature somewhat similar to the one under study. For a given value of $[\text{ICl}_3]_0$, at least two values for a_{ICl_3} are assumed

and the corresponding K 's are calculated. This procedure is carried out for several different values of $[\text{ICl}_3]_0$. The straight line plots of K vs. a_{ICl_3} are then constructed on the same graph. Since there is but one correct K and one value of a_{ICl_3} at a given wave length, the lines should intersect at a common point corresponding to the correct values for these constants. However, there is some scatter in the intersections due to experimental error. When five sets of concentration-absorbance data were treated in this manner, the average of the values corresponding to the ten intersections gave for the equilibrium constant at 25.0° :

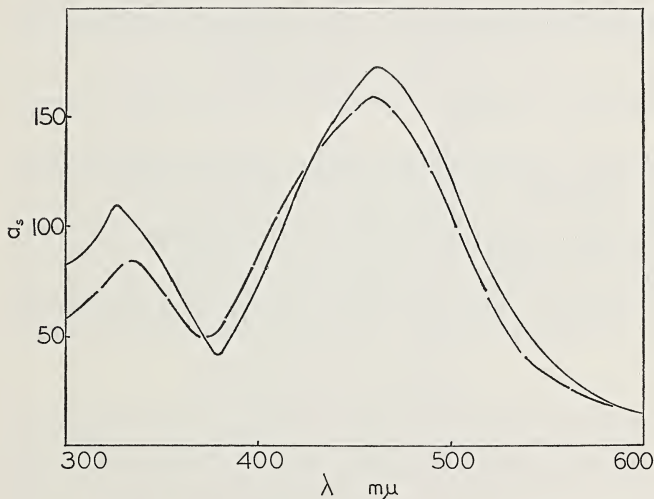
$$K = 2.8 \times 10^{-3} \pm 0.7 \times 10^{-3}$$

The corresponding molar absorbance at $460\text{ m}\mu$ was 172 ± 2 .

The equilibrium concentrations of all species at a given initial concentration of iodine trichloride may be calculated using K . Assuming all substances obey Beer's law, and utilizing the known molar absorptivities

of iodine monochloride and chlorine, the observed absorbancies of the equilibrium mixture can be corrected to give the molar absorbance of iodine trichloride at all wave lengths. Figure 1 shows the calculated molar absorbance of iodine trichloride as a function of wave length in the region 300–600 $m\mu$. For comparison, the apparent molar absorbance of an equilibrium mixture, where the initial concentration of iodine trichlorid was $2.71 \times 10^{-3} M$, is included.

It is readily obvious that the presence of the two absorption maxima is a characteristic of iodine trichloride. The minor maximum of iodine trichloride occurs at about 327 $m\mu$. The major maximum at about 460 $m\mu$ is essentially the same wave length at which maximum absorption for iodine monochloride occurs. The results of this investigation make it clear that the equilibrium expressed by equation (1) must be taken into account when one is dealing with relatively dilute solutions of iodine tri-



EXPLANATION FOR THE GRAPH

Figure 1. Molar absorbance, a_s , as a function of wave length, λ . — corrected curve for iodine trichloride; — — — equilibrium mixture with an initial concentration of iodine trichloride of $2.71 \times 10^{-3} M$. Carbon tetrachloride solvent at 25.0° .

chloride. Furthermore, solutions of iodine trichloride are highly unstable and lose chlorine rapidly thus making it necessary to work with them in closed systems.

SUMMARY

1. The equilibrium $\text{ICl}_3 \rightleftharpoons \text{ICl} + \text{Cl}_2$ in carbon tetrachloride solution at 25.0° has been studied spectrophotometrically. The equilibrium constant has been determined, $K = 2.8 \times 10^{-3} \pm 0.7 \times 10^{-3}$ (mole/l.).

2. The molar absorbance of iodine trichloride has been calculated as a function of wave length in the region 300-600 $m\mu$. Unlike the other iodine interhalogen compounds which possess single absorption maxima in this region, two absorption maxima exist. These maxima occur at about 460 $m\mu$ with a molar absorbance of 172 and 327 $m\mu$ with a molar absorbance of 111.

Acknowledgment. The authors wish to thank Mr. Robert O. Turek for keeping them supplied with pure iodine trichloride throughout this study.

LITERATURE CITED

- Booth, H. S. and W. C. Morris, 1939. Iodine Trichloride. Inorganic Syntheses 1:167-168.
- Buckles, R. E. and J. F. Mills, 1954. A Spectrophotometric Study of Iodine Chloride in Various Solvents. Jour. Amer. Chem. Soc. 76: 4845-4849.
- Rochow, E. G. and I. Kukin, 1952. "Allotropic" Bromine. Jour. Chem. Educ. 29:56-61
- Rose, N. J. and R. S. Drago, 1959. Molecular Addition Compounds of Iodine. I. An Absolute Method for the Spectroscopic Determination of Equilibrium Constants. Jour. Amer. Chem. Soc. 81:6138-6141.

SOME NEW AND UNUSUAL FUNGI FROM VIRGINIA. I. LOWER PHYCOMYCETES

William W. Scott, Roland Seymour, and Charles Warren

Department of Biology
Virginia Polytechnic Institute
Blacksburg, Virginia

(Received for publication July 23, 1962)

INTRODUCTION

There is an obvious paucity of information concerning the occurrence and distribution of fungi from Virginia. There are a few reports scattered throughout the mycological literature of collections made in Virginia, usually by visitors who returned to their home laboratories for the examination and description of such collections. Prior to the studies made by the senior author (Scott, 1960) Virginia was regarded as a relatively untouched area.

During the past six years a systematic collecting of fungi, particularly members of the lower phycomycetous orders, has been undertaken by the senior author and his students. Particular emphasis has been devoted to those fungi associated with diseased fish (Scott and O'Bier, 1962) and to certain other mycological niches (Scott; 1956, 1960, 1961). This report deals with certain miscellaneous fungi obtained in collections of soil and water primarily from bogs in the vicinity of the Mountain Lake Biological Station, and from a variety of sites in the vicinity of Blacksburg, Virginia.

MATERIALS AND METHODS

Fishing for fungi is a standard procedure used by most investigators of the aquatic fungi and has become a common practice among the mycology students from this laboratory. Since the techniques are relatively simple and applicable even in Elementary Botany courses, it seems justifiable to summarize these procedures herein.

Isolation techniques involve the baiting of soil and water samples with sterile pieces of selected organic material (i.e., cellophane or grass leaves as a source of cellulose; shrimp skin or insect exuviae as a source of chitin; snake skin, human skin, hair, nails or feathers as a source of keratin; pine pollen; rose hips or other small fruits; and split halves of hempeed). Such baits may be added to soil samples in water or directly to water

samples in the laboratory or placed in suitable traps and submerged in aquatic sites in the field. The aquatic fungi are oftentimes highly selective in the substrate upon which they will grow. Thus it is possible using a variety of such "baits" to collect and to isolate in pure culture various representatives of the aquatic fungus flora (Sparrow, 1960).

FUNGI COLLECTED

Rhizophylyctis petersenii Sparrow. Proc. Amer. Phil. Soc., 78: 48. 1937. This species, readily distinguished by its large size (zoosporangia up to 115 μ in diameter) and by the formation of a single broad discharge tube, was found once on shrimp skin bait from a bog-soil sample.

Phlyctorhiza variabilis Karling. Amer. J. Bot., 34: 27. 1947. The genus *Phlyctorhiza* was established by Hanson (1946) to include certain monocentric chytridiaceous isolates in which the zoosporangium develops as an outgrowth from the germ tube, while the zoospore remains as a persistent cyst. Later, Karling (1947) added to the genus *P. variabilis*, and Sparrow (1950) described *P. peltata*. The type species, *P. endogena*, was obtained from insect exuviae. All other species described to date as well as our Virginia isolates were obtained on keratinized animal tissues used as bait. As Sparrow (1960) suggested, probably both his isolate and Karling's fungus should be removed from the genus *Phlyctorhiza*. Our isolates lend further support to this suggestion. *P. endogena* forms secondary zoosporangia rarely (only three polycentric thalli were observed) and *P. peltata*, likewise forms polycentric thalli only rarely. *P. variabilis*, however, exhibits a strong polycentric tendency. Our Virginia isolates, tentatively assigned to this taxon, are always polycentric. In certain other respects our isolates are identical to *P. variabilis*.

Blastocladiella spp. An isolate similar in appearance to *B. simplex* was observed once on snake skin bait from a bog water sample.

Blastocladia pringsheimii Reinsch. Jahrb. wiss. Bot., 11: 298. 1878. This species, probably the most common member of the genus, was isolated numerous times from bog water on the skins of apple and tomato baits.

Blastocladia sparrowii Indoh. Science Rep. Tokyo Bunrinda Daigaku, Sect. B, 4: 259. 1940. *B. sparrowii* differs from other members of the genus by the formation of an apically swollen basal cell, the presence of setae, and zoosporangia that exhibit internal proliferation. This report of the occurrence of *B. sparrowii* is new not only to Virginia but for the U. S. It has been reported previously only from Great Britain and India (Sparrow, 1960).

Saprolegnia monoica Pringsheim. Jahrb. wiss. Bot., 1: 292. 1859. As might be expected this and other species of the Saprolegniaceae were

among the most frequently encountered fungi from bog soil and water samples. *S. monoica* was isolated three times on hempseed bait.

Saprolegnia diclina Humphrey. Trans. Amer. Phil. Soc., 17: 109. 1893. *S. diclina* was isolated three times on hempseed bait and from unidentified insect exuviae.

Achlya glomerata Coker. Mycol, 4: 325. 1912. Members of the genus *Achlya* were present in thirty-two collections. They occurred in greater frequency than any other group of water molds. *A. glomerata* was isolated twice on hempseed bait.

Achlya treleaseana (Humphrey) Kauffman. Ann. Rept. Mich. Acad. Sci., 8: 26. 1906. Twenty-seven isolates of this species were obtained from both soil and water samples, and on a variety of baits.

Achlya colorata Pringsheim. Sitzungsber. Acad. Berlin, 1882: 889. 1882. This species was encountered only once on the skin of tomato.

Leptolegnia spp. Isolated only once on insect exuviae from a water sample, this species in water culture never produced sex organs. Thus, species identification was impossible.

Aphanomyces laevis de Bary. Jahrb. wiss. Bot., 2: 179. 1860. *A. laevis* was isolated only once from a decomposing leaf of *Sphagnum* sp.

Leptolegniella keratinophilum Huneycutt. J. Elisha Mitchell. Sci. Soc., 68: 110. 1952. One of the most bizarre species belonging to the Saprolegniaceae, *L. keratinophilum* was isolated a number of times on snake skin bait. It is probably a common inhabitant of the soil particularly from barnyards and other sites rich in organic material. Isolates were also obtained from water samples.

The proper disposition of this fungus is debatable. It is strongly keratinophilic, the mycelium ramifying throughout the substratum and ultimately decomposing the snake-skin. Branching is sparse and irregular; the hyphae range up to 25 μ in diameter. The entire thallus may become converted into a zoosporangium. Zoospores are formed in a unisebate manner and emerge through an elongate discharge tube formed from an undifferentiated hypha. Zoospores are amoeboid, posteriorly biflagellate, and encyst in the vicinity of the parent thallus. Laterally biflagellate secondary zoospores emerge in an amoeboid manner from the cyst, swim for a short period, settle down and give rise to amycelial thallus.

Under conditions as yet undefined, the contents of the thallus may round up, and develop greatly thickened walls. These so-called "resting bodies" or "resting spores" possess a persistent refractive globule. They are highly resistant to desiccation and probably function as chlamydospores or gemmae. Prior to the germination of these "resting spores," the walls

of the parent hyphae disintegrate releasing them and allowing for their dispersal. Germination of the "resting spore" has been observed. These always give rise to mycelium containing more "resting spores", never do they develop into zoosporic thalli.

At this time the relationship between the zoosporic thalli and the "resting spore thalli is not understand. Sexual stages in the life-cycle of our isolates have not been observed. It is suspected that the "resting spores" are formed as the result of sexual fusion. This hypothesis, however, has not yet been substantiated. In a recent report from Japan, Ookubo (1955) described as a new species *L. piligena* based on the fact that antheridia and oogonia were observed. If this be true, the Japanese fungus should be assigned to the genus *Leptolegnia* from which it does not differ in the slightest morphological detail.

Gonopodya polymorpha Thaxter. Bot. Baz., 20: 481. 1895. This fungus is of common occurrence on skins of cherry, apple, tomato and similar fruits used as baits.

Leptomitius lacteus (Roth) Agardh. Systema algarum. p. 47. 1824. Although not previously reported from Virginia, *L. lacteus* is apparently of very common occurrence on submerged fruit baits. It occurs frequently in pustules with species of *Blastocladia*, *Gonopodya*, and *Rhipidium*.

Rhipidium americanum Thaxter. Bot. Gaz., 21: 327. 1896. *R. americanum* is another common species occurring on submerged fruit. It has not been reported previously from Virginia.

Olpidiopsis aphanomycis Cornu. Ann. Sci. Nat. Bot., V. 15: 148. 1872. Parasitic in the hyphae of *Aphanomyces* sp, probably *A. laevis*. Both host and parasite are of common occurrence in permanent ponds from the vicinity of Blacksburg, Virginia.

SUMMARY

A six month study of the aquatic phycomycetous flora of bogs and other aquatic environments in the vicinity of Blacksburg, Virginia, revealed the presence of 18 species representing 12 different genera. Several species were reported for the first time as occurring in Virginia. The taxonomic position of *Phlyctorhiza variabilis* and the life-cycle of *Leptolegniella keratinophilum* were discussed.

LITERATURE CITED

- Hanson, A. M. 1946. A morphological, developmental, and cytological study of four saprophytic chytrids. IV. *Phlyctorhiza endogena* gen. nov., sp. nov. Amer. J. Bot., 33: 732-739, 49 figs

- Karling, J. S. 1947. Keratinophilic chytrids. II. *Phlyctorchiza variabilis*, n. sp. Amer. J. Bot., 34: 27-32, 48 figs.
- Ookubo, M. and Kobayasi, Y. 1955. Studies on the water molds on keratinized materials. Nagooa, 5: 1-10, 6 figs.
- Scott, W. W. 1956. A new species of *Aphanomyces*, and its significance in the taxonomy of the water molds. Va. J. Sc., 7: 170-175.
- Scott, W. W. 1960. The fungus flora of agricultural soils in Virginia. Va. J. Sci., 11: 215-12.9
- Scott, W. W. 1961. A monograph of the genus *Aphanomyces*. Va. Agric. Exp't. Tech. Bull. 151: 95 pp., 9 pls.
- Scott, W. W. and A. H. O'Bier. 1962. Aquatic fungi associated with diseased fish and fish eggs. Prog. Fish Cult., 24: 3-15.
- Sparrow, F. K. 1950. Some Cuban Phycomycetes. J. Wash. Acad. Sci., 40:50-55, 30 figs.
- Sparrow, F. K. 1960. Aquatic Phycomycetes. 1187 pp. Univ. of Michigan Press, Ann Arbor.

A REDESCRIPTION OF THE HYMENOSTOME
CILIATE *Sathrophilus* (*Saprophilus*) *muscorum* (Kahl,
1931) Corliss, 1960, with PARTICULAR ATTENTION
TO THE BUCCAL APPARATUS¹

Jesse C. Thompson, Jr. and Margaret Virginia Cone
Hollins College, Hollins College, Virginia

(Received for publication August 3, 1962)

The taxonomic history of the ciliate order Hymenostomatida has been written primarily from microscopical observations of the living animals. Most staining techniques have added little more than the nuclear apparatus and a "fixed" animal from which more accurate measurements could be taken. The use of these techniques has resulted in a very superficial basis for taxonomic assignment. It is virtually impossible, in most cases to make specific assignment and even generic assignment is difficult. Corliss (1961) included 39 genera in this order but left 36 former genera unassigned chiefly because of insufficient morphological data. Many of the 39 assigned genera are inadequately described.

If the taxonomy of these hymenostome ciliates is to be built upon a solid foundation, then it is necessary to describe new species and redescribe most existing species in light of modern techniques (Corliss, 1958, presents these with selected references). These silver impregnation techniques reveal a variety of structures which most serious workers consider indispensable and are based on the recognition that each species possesses a stable pattern of argentophilic structures. These structures include the basal granules or kinetosomes of the somatic and buccal cilia, cytoproct, contractile vacuole pores, and the often complex fibril network. Such a "protozoan fingerprint" (Thompson, 1960) provides the basis for a precise taxonomic description. By no means should the older techniques and the data which they supplied (life cycles, food, cysts, conjugation, habitats, body form, size, nuclear apparatus, swimming patterns, etc.) be omitted from the descriptions but it should be clearly understood that these data can only be considered as a supplement.

Kahl (1931) described *Sathrophilus* (*Saprophilus*) *muscorum* from moss found in Germany and the United States. His description was very brief and lacking in any details but he included several general character-

¹This investigation was supported in part by Grant 020851 from the National Science Foundation.

istics. These characteristics were the large mouth with membrane, trichocysts, a tube-like structure leading from a sub-terminal contractile vacuole, and long sparse cilia. A drawing was included which showed most of the above structures as well as seven ciliary meridians on one side and a long caudal cilium.

From New Zealand, Stout (1956) rediscovered this species from cultures of gorse and manuka. He was able to confirm Kahl's observations on this species and was also able to add new morphological data. Stout reported the presence of a tetrahymenal buccal apparatus, 15-16 ciliary meridians, and a description of encystment and excystment. His description was lacking in precise details of the silver-line system and was completely inaccurate about the infraciliature of the buccal apparatus.

The present authors have found this protozoan in tree borne lichens and mosses collected at the Mountain Lake Biological Station and reported briefly (1961a and 1961b) on their findings. It is our sincere hope that this redescription of *Sathrophilus muscorum* will provide a lasting morphological basis for future taxonomic recognition. It is also the hope of the senior author that this will be the foundation paper of a series to describe the hymenostome ciliates of Virginia.

MATERIALS AND METHODS

The ciliates were isolated from tree borne lichens and mosses and cultured in a medium consisting of autoclaved lichens and distilled water. Nuclear stains were made using haematoxylin. Phase microscopical observations were made on the living animals and light microscopical studies were made on silver impregnated animals.

MORPHOLOGY OF *Sathrophilus* (*Saprophilus*) *muscorum*

Body Form and Size. The body is a slightly flattened ellipsoid and is rather constant in shape. The average size of 60 silver impregnated specimens was 27.9 x 17.6 micra.

Ciliary Meridians. The rather evenly spread meridians numbered 16 to 17. The first meridian is postoral and ends near the undulating membrane after it bends slightly to the right. The second meridian ends just anterior to membranelle one (see fig. 1). The last meridian (either 16 or 17) runs anteriorly around the left border of the buccal cavity and ends opposite membranelle one. What appears to be a much shortened meridian runs anteriorly from a fibril at the left of the cytoproct around the left border of the buccal cavity. This row of granules was not included in the count of ciliary meridians although it could possibly be a true meridian. A portion of this row of granules can be seen in fig. 1, but most of it is out of focus. A group of granules run obliquely to the left

near the left posterior border of the buccal cavity and can be seen slightly out of focus in fig. 1. The body cilia measured approximately 9 micra and appeared to be more dense anteriorly. A long caudal cilium was present and was generally as long or longer than the body.

Buccal Cavity and Buccal Apparatus. A shallow buccal cavity near the anterior end averages 10.7×6.1 micra. The buccal apparatus consists of three membranelles on the floor and left wall of the buccal cavity and an undulating membrane (UM) on the right border (see figs. 1 and 2). A study of the infraciliature of the buccal apparatus shows membranelle one (M_1) to be the largest. Its anterior end is found anterior to the undulating membrane. It is about 4 micra long and is two or three rows of granules wide. Membranelle two (M_2) is located at the anterior edge of the undulating membrane and measures about 3.5 micra and is two or three rows of granules wide. It possesses a posteriorly directed bar of granules at the anterior end. This bar appears to contain 2 rows of granules. Membranelle three (M_3) is about 2.5 micra long and is somewhat irregular in shape. The infraciliature of the undulating membrane (U.M.) consists of a row of closely set granules along the right border of the buccal cavity. It measures approximately 8.8 micra in length. It starts anteriorly between M_1 and M_2 and continues posteriorly around the posterior border of the buccal cavity. A noticeable break (see figs. 1 and 2) occurs in this row of granules near the posterior end. The U.M. striations (see figs. 1 and 2) appear posterior to M_3 and converge toward the cytostome. They are more numerous and dense posterior to the break in the U.M. The cytostome is located in the floor of the buccal cavity near membranelle 3 and the cytopharynx (CPH) enters the cytoplasm at an angle slightly posterior and to the left of it.

Cytoproct. (CYP) After silver impregnation the cytoproct consists of a narrow row of closely set granules about 4 micra long posterior to the buccal cavity (see figs. 1 and 2). It is connected to the oblique row of granules anteriorly by a fibril.

Contractile Vacuole Pores. A single pore is located near the posterior pole and is usually associated with the first 3 ciliary meridians.

Cyst Formation. Resistant cysts were not studied but must have occurred since dessicated lichens produced living ciliates when cultured in water. Stout (1956) described resistant cysts in his study of this species. Reproductive cysts were not observed and probably did not occur since actively dividing forms were observed.

Life Cycle. The life cycle appeared simple and without polymorphism.

Nuclear Components. Only the macronucleus was observed and measured 9×7 micra.

Stomatogenesis. The details of stomatogenesis were not worked out, but dividing forms were observed to contain typical tetrahymenal stages in the opisthe. The authors believe that stomatogenesis is initiated in the area just posterior to the buccal cavity.

DISCUSSION

Kahl's description of *Sathrophilus muscorum* was very brief (five lines) but he did include several important characteristics as mentioned earlier. But techniques were not available at that time to reveal the details necessary for a precise taxonomic description.

Stout was able to add some new morphological data as previously mentioned, but his description was by no means complete and he was greatly mistaken in his description of the buccal infraciliature. The buccal infraciliature is by far the most important characteristic of this group of ciliates and must be precisely described before even generic assignment can be made. Stout described the first and second membranelles (M_1 and M_2) as consisting of a single row of granules and as being shorter than the third membranelle (M_3). This does not agree with the description as presented by the present authors and as shown in figs. 1 and 2.

The outstanding feature of *Sathrophilus muscorum* is the large buccal cavity, which occupies about one-third of the total body length, and the large tetrahymenal buccal apparatus which it contains.

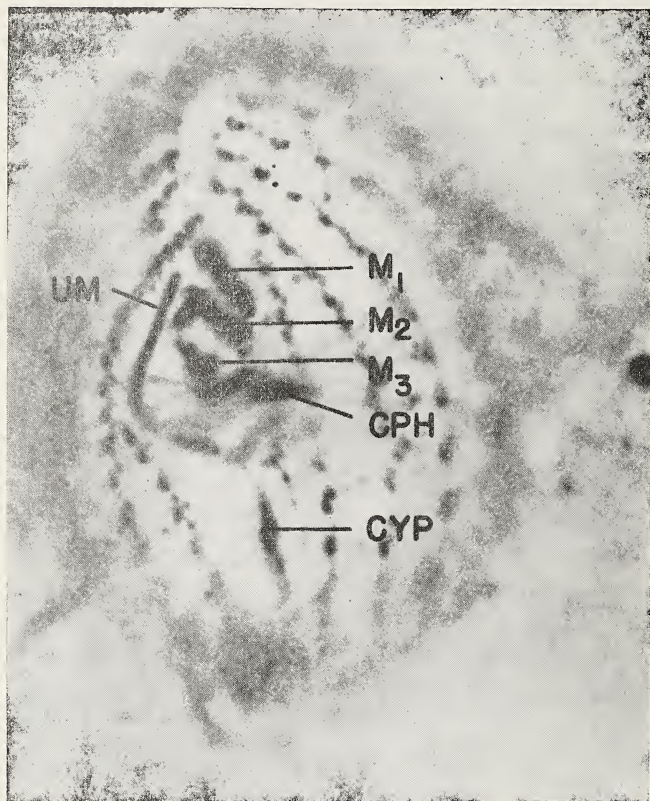
The wide range of distribution of this edaphic species should be noted with interest. It has been isolated from moss, lichens, and forest litter from Germany, Wisconsin, New Zealand, and Virginia.

SUMMARY

Sathrophilus (*Saprophilus*) *muscorum* (Kahl, 1931) Corliss, 1960, a hymenostome ciliate, is redescribed in light of modern techniques. Particular attention is given to the buccal cavity and the buccal infraciliature. Precise morphological data is presented as a firm basis for future taxonomic recognition.

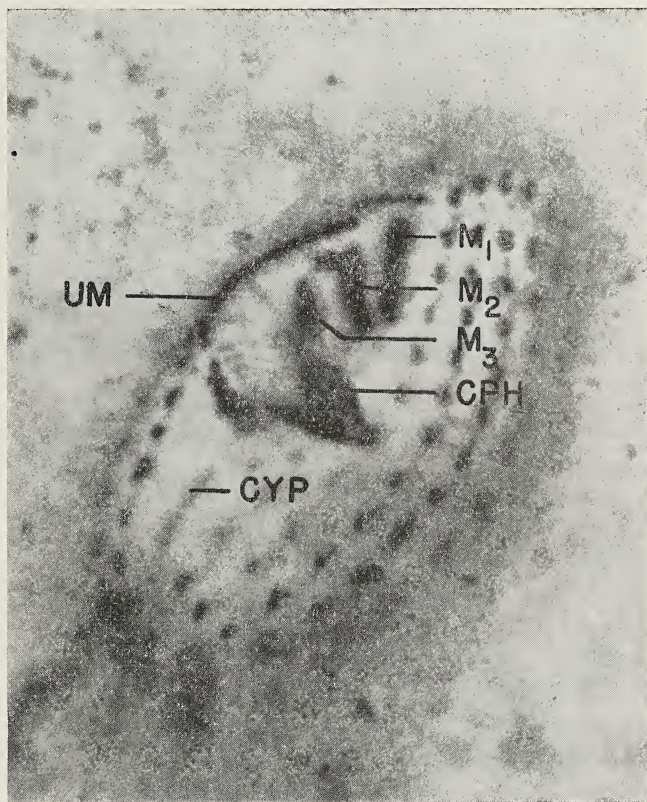
LITERATURE CITED

- Corliss, J. O. 1958. Laboratory techniques in Advanced Protozoology. Univ. of Illinois publications.
- Corliss, J. O. 1960. The Problems of Homonyms Among Generic Names of Ciliated Protozoa, with Proposal of Several New Names. J. Protozoology, 7(3), 269-278.



EXPLANATION OF FIGURE I

Sathrophilus muscorum x 800. Antero-ventral view. UM, undulating membrane; M₁, membranelle 1; M₂, membranelle 2; M₃, membranelle 3; CPH, cytopharynx; CYP, cytoproct.



EXPLANATION OF FIGURE 2

Sathrophilus muscorum x 800. Ventral view. UM, undulating membrane; M₁, membranelle 1; M₂, membranelle 2; M₃, membranelle 3; CPH, cytopharynx; CYP, cytoproct.

- Corliss, J. O. 1961. The Ciliated Protozoa. Pergamon Press, New York.
- Kahl, A. 1931. Urtiere oder Protozoa. I. Wimpertiere oder Ciliata (Infusoria) 2. Holotricha, *Dahl's Die Tierwelt Deutschlands*, part 21, G. Fischer, Jena.
- Stout, J. D. 1956. *Saprophilus muscorum* Kahl, a tetrahymenal ciliate. J. Protozoology. 3 (1) 28-30.
- Thompson, J. C., Jr. 1960. A Protozoan "Fingerprint". Turtox News, 38 (10) 258-259.
- Thompson, J. C., Jr. and Cone, V. 1961a. The Buccal Infraciliature of *Sathrophilus* (*Saprophilus*) *muscorum*. (Abstr.). Va. Jour. Sci., 12 (4) 165.
- Thompson, J. C., Jr. and Cone, V. 1961b. A Redescription of the Hymenostome Ciliate *Sathrophilus muscorum* (Kahl, 1931) Corliss, 1960, with Particular Attention to the Buccal Apparatus. (Abstr.). Proc. First Internat. Conference of Protozoologists (Praha) Aug. 22-30).

News And Notes

(Editor's Note: News contributions should be sent to the person whose name appears at the end of the appropriate sections).

MESSAGE FROM THE PRESIDENT

The forty-first annual meeting of the Virginia Academy of Science will be held in Roanoke on May 1-4, 1963, with headquarters at the Hotel Roanoke. Our hosts for the meeting are Hollins College, Roanoke College and the Virginia Polytechnic Institute. The Academy is most grateful for the hospitality it has enjoyed in past meetings in Roanoke and is looking forward with much pleasure to another very successful meeting.

The annual meeting is held "for the better acquaintance of those interested in all branches of science in Virginia". It is devoted primarily to the presentation of papers in the several sections, the recognition of outstanding scientific talent in our high schools, the conducting of Academy business, and to fellowship among the members.

The annual meeting is by no means the only activity of the Academy. Throughout the year committees and individuals work tirelessly endeavoring to fulfill the objectives of the Academy. These continuing activities are directed by Council to the end that the purposes of the Academy as outlined in Article 2 of the Constitution may be realized. Reports on these activities are given at the Academy Conference on Thursday evening of the annual meeting. All members are urged to attend the Conference, to acquaint themselves with the total program of the Academy, to express pleasure or displeasure with what is being done for science in Virginia, and to suggest additional activities for the Academy.

The Academy is especially proud of its Junior Science program and of the progress which is being made in identifying, stimulating and recognizing scientific ability among our youth. All members of the Academy are urged to support and encourage our Junior Academy program and to attend the papers presented by them at the annual meeting. Here is a chance to get a glimpse of the cream of the young scientific talent in Virginia. Interest shown by a senior may go a long way toward stimulating a junior to a fruitful scientific career.

As the Academy grows in membership it is hoped that it will grow also in the services that it renders to science in Virginia. In order for the Academy to fulfill its objectives and purposes more effectively, it has been suggested that perhaps the time is at hand for us to create an office of Executive Secretary and to undertake the employment of a full-time person for this position. The Council now has this matter under con-

sideration. I am encouraged to believe that progress toward this goal can be reported in the not-too-distant future.

Again, let me urge each and every member to participate in as many of the year-round activities of the Academy as time permits, and to support the full program of the Academy at the 1963 Annual Meeting.

Sincerely,

Jackson J. Taylor

AGRICULTURAL SCIENCE

Dr. Wilson B. Bell, a Past-President of the Virginia Academy of Science, has been appointed Dean of Agriculture at Virginia Polytechnic Institute. Dr. Bell, who was Associate Director of the Virginia Agriculture Experiment Station since 1954 replaced Dean L. B. Dietrick who retired September 30, 1962.

Dr. Herbert M. Kulman initiated a new research program in forest entomology at the Virginia Tech on September 1, 1962. Prior to joining the Department of Entomology and the Department of Forestry and Wildlife he was a member of the staff at the University of West Virginia.

On September 1, 1962, Dr. Michael Kosztarab joined the staff of the Department of Entomology at the Virginia Polytechnic Institute where he will teach courses in insect taxonomy and morphology.

Richard D. Chumney was appointed Commissioner of Agriculture by Governor A. S. Harrison, Jr., effective August 1, 1962, to replace Parke C. Brinkley, who resigned to accept position of Chief Executive Officer for the National Agricultural Chemicals Association.

J. M. Midyette, C. M. Bass and H. L. Smith represented the Virginia Department of Agriculture at the Annual Meeting of the Association of Official Seed Analysts in Miami Beach, Florida. Mr. Midyette moderated the panel discussion on "Need for Standardization and Development of Seed Testing Methods".

Dr. M. D. Lane, of the V.P.I. Biochemistry Department, is on a one-year leave of absence as an NIH Fellow studying with Dr. Feodor Lynen at the Max Planck Institute for Cellular Research, Munich, West Germany. His research at V.P.I. on carboxylation reactions in liver and peanuts will be continued under the direction of Dr. David P. Kosow. Other new Assistant Professors include Dr. Robert R. Schmidt (plant biochemistry) and Dr. Paul D. Lepore (trace minerals nutrition). Mr. James F. Eheart recently retired to join the staff of U.S.D.A in Beltsville, Maryland. Dr. R. W. Engel recently participated in the American Chemical Society symposia on the F.D.A. law and on world food problems as

well as representing the United States at a London Conference on Documentation of Knowledge in Nutrition and Food Technology.

Paul M. Reaves, Professor of Dairy Science at Virginia Tech, received the American Dairy Science Association Teaching Award at the annual meeting of the Association this summer. Along with this award, Professor Reaves received a check of \$1,000 and a plaque.

New staff members in Plant Pathology and Physiology at Virginia Tech are Samuel Bingham, Associate Professor who will investigate chemical weed control; Claude Fordyce, Jr., Assistant Professor, who will study diseases of ornamental plants; John P. Sterrett, Assistant Professor, who will conduct research on chemical brush control; John J. Albert, Instructor in Plant Pathology, who will study fruit diseases.

A laboratory is being established with the aid of a National Science Foundation grant for the purpose of studying plant responses under controlled environmental conditions. The laboratory will contain three individually controlled chambers in which temperature and light intensity can be varied. An infrared gas analyzer will be available for carbon dioxide exchange measurements on plants in the laboratory. The laboratory is being equipped at a cost of \$28,710.00 and will be administered by the Department of Agronomy at V.P.I.

New staff members in the department of Animal Husbandry at Virginia Tech are William R. Backus, Assistant Professor of Meats; Thomas N. Meacham, Assistant Professor of Physiology; Clark B. Theurer, Assistant Professor of Nutrition; and Dale W. Vogt, Assistant Professor of Genetics.

G. W. Thomas, *Section Editor*

ASTRONOMY, MATHEMATICS, AND PHYSICS

From the Mathematics Department of Radford College we hear that Dr. R. N. Pendergrass has resigned as department head to accept an appointment as a professor at Southern Illinois University, Edwardsville. The new chairman is Dr. Mack L. Whitaker.

Dr. Whitaker announces the following additions to the Radford Faculty; Mrs. Helen Bolt Chun, Instructor; Assistant Professors George Gautney, Kermit Hutcheson, and Wallace Lee. Assistant Professor Archie D. Brock is on leave for doctoral study at V.P.I. H. T. Hayslett, Assistant Professor, has resigned to accept a position at Colby College.

The Washington and Lee Physics Department has moved into a new building shared with the Biology Department. Mr. William Barlow Newbolt, graduate of Berea College, has joined the physics faculty. Installation of a telescope in the new observatory atop the Science Building is

expected in February. Under a grant from NSF Undergraduate Research Participation Program, the Physics Department is growing cadmium and zinc single crystals assisted by five students. Later in the year the study will include the study of the properties of these crystals under tension.

Dr. Frank L. Hereford has been named Dean of the Graduate School at the University. Dr. Nicholas Cabrera has been named Chairman of the Physics Department.

Returning from a leave of absence to the Physics Department of V.M.I. is Dr. Richard B. Minnix, Assistant Professor. Philip B. Peters, Instructor of Physics, has been granted leave of absence to work on the doctorate at the University of North Carolina. The V.M.I. Mathematics Department announces the resignation of Dr. Wilbur Whitten who has joined the faculty of the University of North Carolina.

Roanoke College has appointed Dr. Lee Anthony as Head of the Physics Department succeeding Dr. Paul McCorkle who was Acting Head. Dr. Anthony is a graduate of Roanoke and recently completed his doctorate at V.P.I.

From the University of Richmond we hear that Dr. Leonard M. Diana has been appointed Associate Professor of Physics. Dr. Diana, who graduated from the University of Pittsburgh, had been employed by the American Tobacco Company.

D. R. Carpenter, Jr., *Section Editor*

BIOLOGY SECTION

Dr. Raymond O. Flagg on October 1 assumed his new duties as Senior Botanist, and Head of the Department of Botany, with the Carolina Biological Supply Company at Burlington, North Carolina. Dr. Flagg had been Research Associate at the Blandy Experimental Farm.

Walter S. Flory gave an invitational seminar before the staff of the U. S. Horticultural Station at La Jolla, California, on August 22. The following week Dr. Flory presented papers before three of the organizations meeting with the A.I.B.S. at Corvallis, Oregon. Papers prepared in collaboration with Dr. R. O. Flagg were presented before the American Botanical Society and the Society for the Study of Evolution. The latter paper was at the symposium on "Speciation and Phylogeny". The third paper prepared in collaboration with W. R. Singleton, was presented before the Genetics Society of America.

Dr. John G. Barker, formerly Head of the Biology Department at Radford College, has been appointed Head of the Division of Natural Sciences. Two Biology Department members have been added at Radford

College. Miss Betty Newcomer is an assistant professor from the University of Kansas, and Mr. Daniel Marvin is an assistant professor from the University of Ohio.

The School of Marine Science of the College of William and Mary opened its fall term with 22 graduate students enrolled. This school operates through the Virginia Institute of Marine Science at Gloucester Point, Virginia.

During the summer of 1962 the Institute operated two programs under the sponsorship of the National Science Foundation. One was Research Participation for College Teachers and the other, Undergraduate Research Participation. Eight college teachers pursued research for twelve weeks at Gloucester Point including: Mr. Roland W. Batten, Frederick College, Portsmouth; Dr. R. L. Ellison, the University of Virginia; Dr. L. R. Emmons, Washington and Lee University and Dr. W. W. Scott, Virginia Polytechnic Institute. Undergraduate students from Virginia colleges included: Carl S. Hacker, and Sally Y. Long, College of William and Mary; and Ann Thompson, Christopher Newport College. Seven other students from out of state were also enrolled in this program.

Dr. Morris L. Brehmer, Senior Marine Scientist, has received a contract from the National Institute of Health to study, "Toxicity of Industrial Wastes in Virginia Marine Waters". John Norcross, Associate Marine Scientist, is engaged with the U.S. Navy in a cooperative study of "Surface and Sub-surface Circulation, Including the Interaction of the Bay Waters over the Continental Shelf."

The following new staff members joined the Department of Biology at Virginia Tech: Dr. Robert E. Benoit, assistant professor of Bacteriology; Dr. Rhodes B. Holliman, assistant professor of Zoology; Dr. Duncan T. Patten, assistant professor of Botany; Dr. Richard E. Phillips, assistant professor of Zoology; Dr. David A. West, assistant professor of Zoology; and Dr. Cleo D. Wilder, Jr., assistant professor of Zoology.

Dr. Perry C. Holt, associate professor of Zoology in the Department of Biology at VPI, concluded the field work connected with his study of the systematics of the family Branchiobdellidae this summer with a collecting expedition to Mexico. Previous field work from 1958 through 1961 has been done in, or collections received from other collectors from 41 of the states of the Continental United States. The results of the Mexican trip, therefore, complete a fairly thorough survey of North America. This work has been supported since 1957 by the National Science Foundation.

S. E. Neff, Department of Biology, VPI, has returned to Blacksburg after attending the NSF-sponsored Institute of Comparative Anatomy at

Quality



Products of *The American Tobacco Company*

© A. T. Co.

"Tobacco IS OUR MIDDLE NAME"

Harvard University this summer. He also attended the XV International Congress of Limnology at Madison, Wisconsin, and presented a paper on the use of fly larvae in the biological control of medically-important snails. Dr. Neff will conduct a three-year study supported by the National Science Foundation on the immature stages of the Scatomyzinae. The investigation will be carried out as a part of the Limnology Program at VPI.

The Department of Biology of the University of Virginia has been joined by two new members. Visiting professor Howard L. Hamilton and assistant professor J. J. Murray, Jr. Dr. Hamilton comes to Virginia from Iowa State University where he served as professor and chairman of the department of Zoology for several years. Dr. Murray taught at Washington and Lee University before going to Oxford University where he was recently awarded his doctorate in Zoology.

Dr. Mary Humphreys, Mary Baldwin College, attended the June field trip of the Northeastern Section of the Botanical Society of America which met at the University of Delaware.

Dr. Dorothy Crandall, Randolph Macon Woman's College, is on sabbatical leave this semester working in the Soil Department of North Carolina State. Her replacement is Mr. William S. Hooks who comes from Northern Illinois University.

Mr. M. W. Scott has joined the Hampden-Sydney faculty as instructor in Biology.

Dr. Bruce L. Welch, assistant professor of Biology, and Mr. Garnett R. Brooks, Jr., instructor in Biology, have joined the staff of the College of William and Mary.

Dr. T. M. Harris has joined the staff at the University of Richmond as assistant professor of Biology.

Dr. W. S. Woolcott, University of Richmond, spent six weeks during the past summer collecting fishes at the Highlands Biological Station.

Dr. Jack Burke, University of Richmond, has recently been awarded a \$26,500 continuation grant from the National Institute of Health for hemoglobin studies in the blood of fishes.

Dr. Jesse C. Thompson, Jr., Hollins College, will be on sabbatical leave the second semester of this year. He will leave Hollins either February first or June first to participate in the International Indian Ocean Expedition. Dr. Thompson will spend ten weeks at Mandapam Camp in Southern India investigating the ciliated protozoa of the Indian Ocean.

Dr. Paul J. Osborne, Biology Department of Lynchburg College, has

**Representing
the
Most
Respected
Manufacturers
in the
Laboratory
Supply
Industry**

Corning Glass • Kimble Glass •
Coors Porcelain • Nalge Plastics
• Sheldon Furniture • Beckman
Instruments • Coleman Instru-
ments • American Optical Com-
pany • Bausch & Lomb, Inc. •
Eberbach Corporation • Inter-
national Equipment Company •
Burrell Corporation • Labora-
tory Equipment Company •
Ainsworth Balance • Ohaus
Balance • U.S. Stoneware •
J. T. Baker Chemicals • Mal-
linckrodt Chemicals • Matheson
Coleman & Bell Organics •
Precision Scientific Company •
Labline, Inc. • Thermolyne
Corporation • Buehler, Ltd. •
Baltimore Biological • Difco
Laboratories • Wm. Boekel &
Company • Humboldt Manufac-
turing Company • Hevi-Duty
Electric Company • W. A.
Taylor Company • Sartorius
Balance • Torsion Balance •
Hellige, Inc. • Plus Many
Others.

Serving the South for over 35 years

PHIPPS & BIRD, INC.



MANUFACTURERS AND DISTRIBUTORS OF SCIENTIFIC EQUIPMENT

6TH & BYRD STREETS — RICHMOND, VA.

PHONE MI 4-5401

resumed teaching duties after a sabbatical year in the Physiology Department of the University of North Carolina.

Edward B. Cutler has joined the Biology Staff of Lynchburg College. Mr. Cutler has been selected as a member of the International Indian Ocean Expedition for the summer of 1964, to collect and study the new animal phylum, Pogonophora. Following the Indian Ocean cruise, the expedition will spend two months at a marine laboratory in Madagascar.

J. C. Thompson, *Section Editor*

STATISTICS

John M. Long resigned as Chairman of the Statistics Section on September 1, 1962. Vice President Victor Chew will be acting president for the remainder of the year. Mr. Long accepted a position at the University of Arkansas, School of Medicine, Little Rock, Arkansas, as an Associate Professor of Biometrics.

H. A. David of the Department of Statistics at Virginia Tech has been elected President of the Eastern North American Region of the Biometric Society.

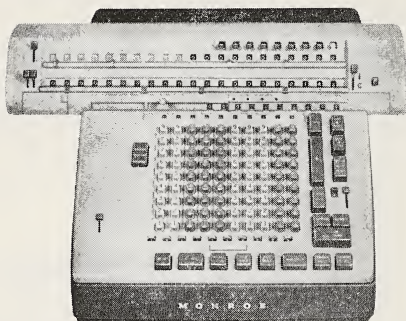
The Department of Statistics of the Virginia Polytechnic Institute announces the following new staff additions:

Leonard R. Shenton, Professor, B.Sc., Ph.D., D.Sc.; John L. Gill, Associate Professor, B.S., M.S., Ph.D.; Whitney L. Johnson, Associate Professor, B.S., M.S.; John G. Saw, Associate Professor, B.Sc., Ph.D.; Raymond H. Myers, Assistant Professor, B.S., M.S.; Frederic C. Barnett, Instructor, B.S., M.S.; Roger E. Flora, Instructor, B.S.; Waldemar E. Heinzelmann, Instructor, B.S.

The Department, for the fall term 1962, has enrolled 50 graduate students with approximately one-third working toward their Ph.D. degrees. Fellowships and teaching assistantships for the year 1963-64 ranging in stipends from \$1600 to \$2500 are available. Inquiries should be sent to Boyd Harshbarger, Head, Department of Statistics, V.P.I., prior to February 1, 1963.

Jean D. Gibbons has been awarded the Ph.D. degree in Statistics at Virginia Tech and is now Assistant Professor of Mathematics at the University of Cincinnati. Her dissertation is entitled "The small-sample power of some nonparametric tests".

C. Y. Kramer, *Section Editor*



Schizophrenic!

The new IQ-213 won't believe it is merely a calculator. It is. But it refuses to act like one. Too limiting. It solves problems with greater speed and fewer operator decisions than any previous calculator ever has, reducing most computational activity to mere push-button procedures. It stores ten digit constants in its memory for recall whenever you want them. It enables you to multiply a large constant by a smaller variable. It even recalls constant divisors from memory—something no calculator has ever before been able to do—thereby eliminating the need for reciprocals in most problems. All at the touch of a single button! Additionally, it automatically programs itself for every calculation, removing the need for any manual positioning, clearing, or setting when changing from one arithmetic sequence to

another . . . and eliminates the physical handling of intermediate figures usually necessary on ordinary calculators. (In a three-factor problem, each figure can be loaded into the machine before the first multiplication takes place. Press the button and the problem unravels itself!) What's more, it automatically accumulates multipliers (as a by-product of squaring in standard deviation) and quotients (in correlation work). No wonder it rebels at being categorized with machines so much more limited! Actually, it is simply the most automatic and most accurate calculator ever produced, well worth its price of one thousand eighty-five dollars. See for yourself. Call your local Monroe representative (he's listed in the phone book) for a demonstration today.

MONROE 

GENERAL OFFICES: ORANGE, NEW JERSEY • A DIVISION OF LITTON INDUSTRIES

FINANCE REPORT

STATEMENT OF DISBURSEMENTS PERIOD ENDING DECEMBER 31, 1961

	Approved Budget 1961	Disbursed 1961	Proposed Expenditures 1962
AAAS Travel Expenses	350.00	413.70	350.00
Academy Conference Dues	20.00	20.00	20.00
W. Catesby Jones Award	10.00	10.00	10.00
E. C. L. Miller Award	50.00	50.00	50.00
Junior Academy Activities (including Philip-Morris and American Tobacco Co. Grants)	2,000.00	1,874.99	2,000.00
Science Talent Search	600.00	595.82	700.00
Annual Meeting Expenses	500.00	563.41	700.00
Audit — Tax Service	400.00	425.00	475.00
Treasurer's Bond Premium	12.50	12.50	12.50
P. O. Box Rent	32.00	32.00	32.00
Stationery, Supplies, Steno.	200.00	62.08	125.00
Postage, Section Expenses, Printing and Addressograph Service	450.00	753.36*	700.00
*Postage, Section Expense—237.57) Printing, Addressograph—515.79)			
Cost of VISR Bldg. Fund Promotion			100.00
Va. Journal of Science	2,100.00	2,300.00**	2,100.00
Miscellaneous	125.00	112.50	150.00
Corporation Charter Fee	5.00	5.00	5.00
Donation VISR Bldg. Fund	—	200.00	—
Annual Meeting Programs and Subsidy for Proceedings	500.00	161.00***	500.00
	<u>7,354.50</u>	<u>7,591.36</u>	<u>8,029.50</u>

Expenditures over budget 1961 — \$236.86

Cash on Hand 1 January 1961 — 2,736.43

*Includes 2 Printings of leaflets

**Shelves for old Journals

***Does not include expenditure for 1961 Proceedings of \$444.50

VIRGINIA ACADEMY OF SCIENCE—1961

INCOME 1961

ESTIMATED INCOME 1962

34

THE VIRGINIA JOURNAL OF SCIENCE					January	
<i>Dues</i>						
Regular Members	697	@	3.00	\$2,091.00	780	\$2,340.00
Contributing Members	177	@	5.00	888.00	180	900.00
Sustaining Members	52	@	10.00	520.00	60	60.00
Student Members	23	@	2.00	46.00	30	60.00
Business Members	14	@	100.00	1,400.00	20	2,000.00
Back Dues				299.00		250.00
Total	963			\$5,244.00		\$6,150.00
<i>Gifts</i>						
Philip Morris Tobacco Company				1,000.00		1,000.00
American Tobacco Company				200.00		200.00
W. Catesby Jones Award				10.00		10.00
Anonymous Bequest				2,500.00		
				3,710.00		1,210.00
<i>Miscellaneous</i>						
Sale of James River Basin (8 @ 3.50)				28.00		35.00
Stock Dividends				91.65		110.00
Special Fund Income				285.00		325.00
				404.65		470.00
<i>Meeting Income</i>						
Exhibit Fees				780.00		1,125.00
Registration Fees				538.80		500.00
				1,318.80		*100.00
				\$10,677.45		1,725.00
						\$9,555.00
GRAND TOTAL						
RESEARCH A/C Total Receipts				\$1,328.67		
(Inc. \$270.00 AAAS)						
Total Expenditures				1,345.00		
						(* Estimated income from Anonymous gift)

BUSINESS MEMBERS
VIRGINIA ACADEMY OF SCIENCE

Albemarle Paper Manufacturing Company
Allied Chemical Corporation
The American Tobacco Company
Dan River Mills
The Dow Chemical Company
E. I. du Pont de Nemours and Company, Inc.
First and Merchants National Bank
General Electric Company
Larus and Brother Company, Inc.
The Newport News Shipbuilding Company Foundation
Norfolk and Western Railway Company
Philip Morris and Company, Limited, Inc.
Phipps and Bird, Inc.
Reynolds Metals Company
A. H. Robins Company
Southern Materials Company
State-Planters Bank of Commerce and Trusts
Virginia-Carolina Chemical Corporation
Virginia Chemicals and Smelting Company

THE ANNUAL SUBSCRIPTION RATE is \$3.00, and the cost of a single number, \$1.00. Reprints are available only if ordered when galley proof is returned. All orders except those involving exchanges should be addressed to Carl W. Allen, Virginia Polytechnic Institute, Blacksburg, Virginia. The University of Virginia Library has exclusive exchange arrangements, and communications relative to exchange should be addressed to The Librarian, Alderman Library, University of Virginia, Charlottesville, Virginia.

NOTICE TO CONTRIBUTORS

Contributions to the Journal should be addressed to Paul B. Siegel, Virginia Polytechnic Institute, Blacksburg, Virginia. If any preliminary notes have been published on the subject which is submitted a statement to that effect must accompany the manuscript.

Manuscripts must be submitted in triplicate, typewritten in double spacing on standard 8 1/2" x 11" paper, with at least a one inch margin on all sides. Manuscripts are limited to seven pages, with the proviso that if additional pages are desired, the author may obtain them at cost. The author may estimate the length of his paper by counting the total number of characters, including blank spaces, and dividing this by 3300. The result is the approximate number of printed pages in the Journal.

Division of the manuscript into subheadings must follow a consistent plan. It is desirable that a brief summary be included in all manuscripts.

Footnotes should be included in the body of the manuscript immediately following the reference, and set off by a dashedline above and below the footnote content. Footnotes should be numbered consecutively from the beginning to the end of the manuscript.

References should be arranged alphabetically according to author. Each reference should include the date, full title of the article, the name of the Journal, the volume and pages. For example: Harvie, L. E. and S. P. Maroney, Jr., 1961. Respiration and hemolysis of ultraviolet irradiated frog erythrocytes. *Va. Jour. Sci.* 12:1-9. References to the bibliographic citations should not be made by numbers. Instead, using the above citation, where a reference is desired: either (Harvie and Maroney, 1961) or Harvie and Maroney (1961).

Explanation of graphs and tabular material should be typed on separate pages. All figures should be numbered consecutively beginning with the first text figure and continuing through the plates. If figures are to be inserted in the text this should be indicated at the appropriate place in the margin.

Illustrations including lettering, should be arranged so that on reduction they will not exceed the dimensions of the maximum size of a printed page. Large plates must be accompanied by photographic copies which can be sent to the reviewers. The Journal will furnish the author with one plate or its equivalent; additional figures, colored illustrations or lithographs may be used only if the author makes a grant covering the cost of production. Original drawings (which must be done in black drawing ink) not photographs of drawings, should accompany the manuscript. When photographic prints are used they should be glossy, sharp and show good contrast. Drawings not neatly executed and labeled (do not use a typewriter), or which are not submitted on white paper will not be accepted.

Galley proofs are sent to the author for correction. Costs of excessive changes from the original manuscript must be defrayed by the author.

OFFICERS OF THE VIRGINIA ACADEMY OF SCIENCE

Jackson J. Taylor, *President*
Foley F. Smith, *President-Elect*
Paul M. Patterson, *Secretary*
Rodney C. Berry, Sr., *Treasurer*
William B. Wartman, *Assistant Secretary-Treasurer*

COUNCIL

P. A. Hansen	E. D. Brand	B. Harshbarger
H. G. M. Jopson	J. L. Calver	Suzie V. Floyd
G. T. Miller, Jr.	J. M. Grayson	E. F. Turner, Jr.
S. B. Row	S. B. Williams	H. Leidheiser, Jr.
P. B. Siegel	R D. Hughes	W. W. Scott

50573

V81

Q1
V5X
NH

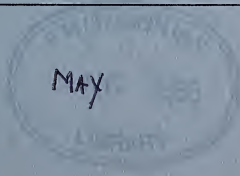
THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE

Vol. 14, New Series

April, 1963

No. 2





VOL. 14, NEW SERIES

No. 2

APRIL, 1963

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND
SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

Printed by *The Bassett Printing Corporation*, Bassett, Virginia

CONTENTS

	<i>Pages</i>
The Absorption Spectrum of T-1824 Dye in Swine Plasma. J. D. Burke	37
Pure Culture Techniques Applied to the growth of a <i>Saprolegnia</i> spp. on a Chemically Defined Medium. W. W. Scott, J. R. Powell and R. L. Seymour	42
Some New and Unusual Fungi from Virginia. II Aquatic Hyphomycetes. W. W. Scott and C. J. Umphlett	47
News and Notes	65
Program of the Forty-First Meeting	79

EDITORIAL BOARD

Paul B. Siegel, *Editor*

Carl W. Allen, *Managing Editor*

SECTION EDITORS

W. P. Anslow, Jr.	C. Y. Kramer	W. T. Parrott
D. R. Carpenter, Jr.	A. Mandell	F. B. Rowe
P. A. Hansen	N. F. Murphy	G. W. Thomas
M. A. Kise		J. C. Thompson

Entered as second-class matter, at the post-office at Bassett, Virginia, and Blacksburg, Virginia, under the Act of March 3, 1897. Subscription \$3.00 annually. Published four times a year: in January, April, July and September by the Virginia Academy of Science at Blacksburg, Virginia.

Mailed April 15, 1963

THE VIRGINIA JOURNAL OF SCIENCE

VOL. 14, NEW SERIES

APRIL, 1963

No. 2

THE ABSORPTION SPECTRUM OF T-1824 DYE IN SWINE PLASMA

Jack D. Burke
University of Richmond

(Received for publication July 18, 1962)

The first blood volume determination using a dye was reported by Keith *et al.* (1915). Subsequent investigations of specific dyes in blood volume studies by Dawson *et al.* (1920), Harris (1920), Hooper *et al.* (1920), Graff and Clark (1931), Gregersen *et al.* (1935), Gibson and Gregersen (1935), Gibson and Evans (1937), Gregersen and Schiro (1938), and Gibson and Evelyn (1938) indicated clearly that many blue dyes were superior to certain red dyes in toxicity, exocirculatory diffusion, steady state equilibrium involving mixing time and non-absorption by red blood corpuscles, and instrumentation.

The 1935 paper by Gregersen *et al.* was the first literature report of the use of T-1824 blue dye, Color Index 23860 $[2,4-(\text{NaOSO}_2)_2\text{C}_{10}\text{H}_8-1-\text{NH}_2-8-\text{OH}-7-\text{N:N}-4-\text{C}_6\text{H}_5-3-\text{CH}_3]_2$, in determining blood volumes. These workers found that the peak absorption of this dye was 620-630 m μ . They then pointed out that the maximum absorption range of hemoglobin is 544-576 m μ .; and if hemolysis occurred in the sample, there would be practically no light absorption by hemoglobin. The peak absorbance for the vital red dyes is about 520 m μ . which is closer to the absorption range for hemoglobin; consequently, hemolysis could result in error. Thus, blood volume determination using T-1824 dye has become an acceptable method (Burke, 1954). However, it should be emphasized that an absorption curve ought to be plotted for the T-1824 dye when it is used to determine blood volume in order to insure that the plasma or some other factor does not in some way change the characteristics of the dye.

METHODS AND MATERIALS

A precise procedure for determining blood volume using T-1824 was

given by Burke (1958), but the essence of the technique applicable here is as follows. An exact volume of dye with a known concentration is injected into the blood circulation of an animal. At a certain interval of time, a blood sample is withdrawn. The optical density of the deproteinated plasma of the sample is compared photometrically with the optical density of a standard dye in deproteinated plasma solution at peak absorption. The amount of dilution of the dye gives an estimate of the plasma volume. Then the total blood volume can be calculated from the plasma volume and plasma hematocrit value.

RESULTS

In Fig. 1 are shown the absorption spectra of two T-1824 dye solutions determined on a Beckman DU spectrophotometer in the wave-length range 500-700 m μ , where wave-length is plotted against optical density. One absorption curve was determined on a dye in water (0.01 mg/ml) solution; the other curve was determined on a withdrawn plasma sample which had been deproteinated after 10 ml of the dye solution (2 mg/ml) had been injected into a swine.

DISCUSSION

In order to determine the concentration of a light-absorbing substance present in a solution, it is necessary to measure photometrically the light transmittance (T) of that solution. It is convenient to plot $-\log T$ against concentration which will result in a straight line with a positive slope in systems which follow Beer's Law. The quantity $-\log T$ is expressed as optical density. This represents the simplest relation between light absorption and concentration since optical density is directly proportional to concentration (Hawk *et al.*, 1954).

Reference to Fig. 1 shows an absorption curve for dye in water, and another curve on a deproteinated plasma sample tagged with dye that was taken from an animal after the dye was injected into the circulation. A comparison of the two peaks of absorption shows that the peak for each curve is at 622 m μ , although the dye concentrations are different in each solution. This peaking of the two curves at the same point assures the validity of using T-1824 dye in determining blood volume in swine.

SUMMARY

In summary, it has been shown that the passage of T-1824 dye through the circulation of swine and the subsequent treatment of the tagged plasma sample do not alter the peak absorption at 622 m μ .

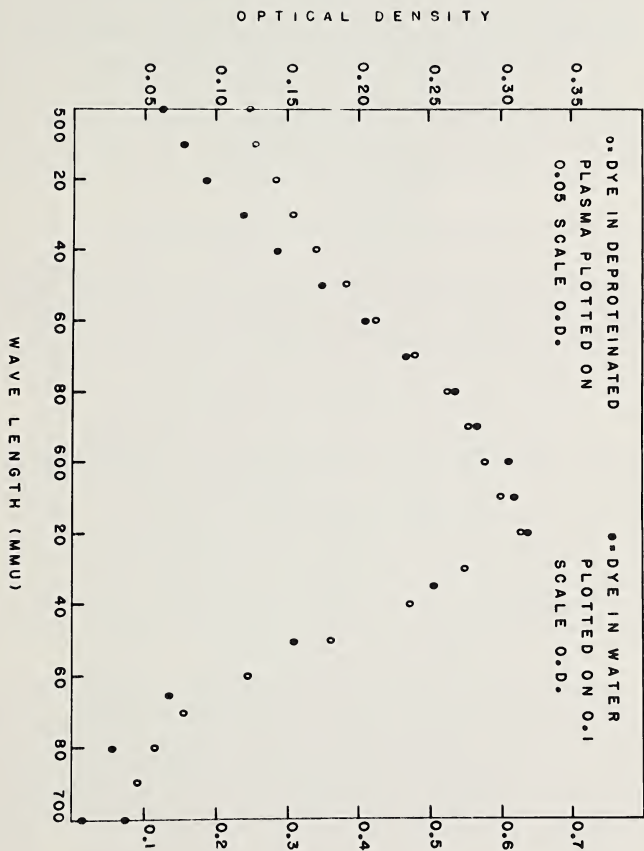
ACKNOWLEDGMENTS

I would like to express my appreciation to Dr. Ray Shirley, Dr. George Davis, and Dr. Jack McCall of the Nutrition Laboratory of the University of Florida for their aid during this investigation; to Dr. H. D. Wallace of the College of Agriculture, University of Florida for providing the swine; and to my wife for the preparation of the graph. My thanks also given to Dr. W. Allan Powell, Department of Chemistry of the University of Richmond, for technical advice in writing the paper.

LITERATURE CITED

- Burke, J. D. 1954. Blood Volume in Mammals. *Physiol. Zool.* 27:1-21.
- Burke, J. D. 1958. A Procedure for Simultaneous Blood Volume Determinations Using Radioactive Phosphorus-32 and T-1824 (Evans blue) Dye. *Va. Jour. Sci.* 9: 253-260.
- Dawson, A. B., H. M. Evans, and G. H. Whipple. 1920. Blood Volume Studies. III. Behavior of Large Series of Dyes Introduced into the Circulating Blood. *Amer. Jour. Physiol.* 51:232-256.
- Gibson, J. G., and W. A. Evans. 1937. Clinical Studies of the Blood Volume. I. Clinical application of a method employing the Azo dye "Evans blue" and the Spectrophotometer. *Jour. Clin. Invest.* 16:301.
- Gibson, J. G., and K. Evelyn. 1938. Clinical Studies of the Blood Volume. IV. Adaptation of the Method to the Photoelectric Microcolorimeter. *Jour. Clin. Invest.* 17: 153-158.
- Gibson, J. G., and M. I. Gregersen. 1935. Toxicity of Two Vital Dyes Used in Plasma Volume Determinations. *Amer. Jour. Physiol.* (P). 113:50.
- Graff, S., and H. T. Clarke. 1931. Determination of Plasma Volume. I. The Dye Method. *Arch. Int. Med.* 48:808-820.
- Gregersen, M. I., J. G. Gibson, and E. A. Stead. 1935. Plasma Volume Determination with Dyes: Errors in Colorimetry; Use of Blue Dye T-1824. *Amer. Jour. Physiol.* 113:54-55.
- Gregersen, M. I., and H. Schrio. 1938. The Behavior of the Dye T-1824 with Respect to its Absorption by RBC and its State in Blood undergoing Coagulation. *Amer. Jour. Physiol.* 121:284-292.
- Harris, D. T. 1920. The Value of the Vital-Red Method as a Clinical Means for the Estimation of the Volume of the Blood. *Brit. Jour. Exptl. Path.* 1:142-158.

- Hawk, P. B., B. L. Oser, and W. H. Summerson. 1954. *Practical Physiological Chemistry*. McGraw-Hill, N. Y. 13th Edition.
- Hooper, H. P., H. P. Smith, A. E. Belt, and G. H. Whipple. 1920. Blood Volume Studies. I. Experimental Control of a Dye Blood Volume Method. *Amer. Jour. Physiol.* 51:205-220.
- Keith, N. M., L. G. Rowntree, and J. T. Geraghty. 1915. A Method for the Determination of Plasma and Blood Volume. *Arch. Int. Med.* 16:547-576.



PURE CULTURE TECHNIQUES APPLIED TO THE GROWTH OF *SAPROLEGNIA* spp. ON A CHEMICALLY DEFINED MEDIUM¹

W. W. Scott, J. R. Powell, and R. L. Seymour

Department of Biology
Virginia Polytechnic Institute
Blacksburg, Virginia

(Received for publication July 23, 1962)

In almost all mycological studies of a taxonomic or a physiological nature, it is essential to secure and maintain in pure culture isolates of the fungi under observation. In many cases unifungal cultures are difficult to obtain free from bacterial contamination. This preliminary step in one's investigation is often tedious and time consuming. Therefore, a rather extensive account of the methods used here may prove of value to future investigators dealing with this genus or with similar fungi.

As a group, members of the Saprolegniaceae are especially troublesome to isolate in pure culture. The difficulties encountered are due to several factors. First, these fungi generally occur in nature accompanied by large numbers of bacteria, protozoa, algae, and other fungi. Second, the saprolegniaceous fungi are usually slower in their rates of growth than are many of the accompanying contaminants. Third, the fungus hypha is surrounded by a film of water by means of which the contaminants are able to accompany the filament during growth. Lastly, most species of water molds have temperature and water requirements similar to those of the common contaminants which accompany them.

Before attempting to identify and describe isolates of aquatic fungi, it is of considerable importance that they be grown and observed under standardized conditions. Johnson (1956) and Scott (1961), like most students of the water molds, depended chiefly on the use of hempseeds (*Cannabis sativa*) for the isolation and maintenance of such fungi in water-culture. Recent studies conducted in this laboratory (Scott and O'Bier, 1962) indicate the desirability of using a chemically defined substrate as a substitute for hempseed.

¹This study was supported in part by a grant from the National Science Foundation, G-17614, awarded to the senior author.

The present investigation concerns the use of a medium modified from that originally employed by Reischer (1951) for culturing members of the Saprolegniaceae. Although this medium was designed for use in nutritional studies of *Achlya klebsiana*, our preliminary studies confirmed Reischer's observations that other genera including *Saprolegnia* could be grown on it. However, certain modifications were found necessary in order to convert Reischer's liquid medium to a form as convenient to use as hemp-seed. Henceforth our modification of Reischer's medium will be referred to as SPS agar. The experimental objective was to establish unifungal bacteria free cultures of *Saprolegnia* spp. on this chemically defined substrate.

During preliminary studies it was found extremely difficult to obtain single spore isolates without bacterial contamination. Therefore, Raper's ring technique (Raper, 1937) was employed using SPS agar. In this manner agar blocks, free of bacteria were obtained removed from the medium, and conveniently placed in water culture. The subsequent production of sexual structures, rarely encountered in synthetic media, encouraged the development of more refined techniques reported here.

MATERIALS AND METHODS

The reagents listed below (Fisher Certified Reagents) were added in the order given and dissolved in predistilled, ion-exchanged water (Fisher Amberlite MB-3 ion-exchange resin).

TABLE 1. The Ingredients of SPS Agar

1.	Chelation agent:		
	Ethylenediaminetetraacetic acid	0.5	grams/liter
2.	Buffer for pH 7.0:		
	K ₂ HPO ₄	0.17	"
	KH ₂ PO ₄	0.14	"
3.	Inorganic nutrients:		
	MgCl ₂ . 6H ₂ O	1.0	"
	CaCl ₂ . 6H ₂ O	0.02	"
	MnCl ₂ . 4H ₂ O	0.06	"
	ZnCl ₂	0.04	"
	FeCl ₃ . 6H ₂ O	0.0013	"
4.	Organic Nutrients:		
	D L Methionine	0.05	"
	Glucose	5.0	"
	Sodium glutamate (mono)	2.0	"

5. Dissolve the ingredients of steps 1, 2, 3 and 4 in 971 ml. pre-distilled ion-exchanged water and adjust the pH of the solution to 7.0 with KOH pellets.
6. Agar (Difco Bacto-agar). 20.0 "
Add to the above solution.
7. Autoclave the medium at 15 lbs. for 30 minutes.

Unifungal hempseed cultures of *Saprolegnia anisospora*, *S. delicata*, *S. dictina*, *S. ferax*, *S. lapponica*, *S. litoralis*, *S. monoica*, and *S. terrestris*² were each placed within a glass ring (O. D.: 5/8 in.; height: 1/2 in.) secured by SPS agar in the center of a petri dish (O. D.: 4 in.; height: 1 in.). Cultures were prepared and incubated at room temperature (25° C.) for 18 hours. At the end of the incubation period a dense mycelial growth was observed on the agar outside the glass ring. An agar block (area: 1/4 in.²) containing mycelium was cut at the periphery of the culture and placed aseptically in a petri dish containing predistilled, ion-exchanged water and two blocks of uninoculated SPS agar. One such culture was prepared for each species and incubated at 10°C. Each culture was examined periodically for the presence of antheridia and oogonia. All isolates except *S. dictina* and *S. terrestris* produced sexual structures.

DISCUSSION

Except for the work of Volkonsky (1933), Bhargava (1945). Whiffen (1945), and Reischer (1951) there is a paucity of information in the literature concerning the application of chemically defined media to the growth of *Saprolegnia spp.* Of these, the medium suggested by Reischer proved to be the most feasible for our purposes. However, certain modifications in Reischer's medium were found necessary to adapt it for our culture needs. In accordance with her suggestions, copper, molybdenum, boron, and cobalt were omitted. Also, magnesium chloride was substituted for magnesium sulfate since it was reported that the Saprolegniaceae are unable to reduce sulfate. Moreover, the concentrations of inorganic nutrients were increased to compensate for molecular water in the reagents thus maintaining an adequate nutrient level.

Methionine (DL) in combination with glucose and sodium glutamate was selected in preference to ethanol, sodium succinate, and ammonium nitrate because their use was considered less cumbersome. Adjustment to pH 7.0 was facilitated by using pellets of potassium hydroxide. Predistilled ion-exchanged water was used in all solutions and in water culture to eliminate the presence of unknown solutes. The use of agar in Reis-

²All strains were isolates from Centraalbureau voor Schimmelfcultures, Baarn, Netherlands.

cher's liquid medium was our own innovation and proved a convenience both in Raper's ring technique and in the maintenance of cultures. Of necessity, glucose was autoclaved with the rest of the medium to further simplify preparation. No caramelization occurred nor did the pH deviate significantly from 7.0 after sterilization.

Of the eight species of *Saprolegnia* cultured, six produced antheridia and oogonia during a six weeks period. A later examination of *S. dictyna* and *S. terrestris* also revealed the presence of antheridia and oogonia. In all the above cultures oospore germination was observed.

As far as we know this is the first report of sexual structures and the germination of oospores occurring in pure cultures of *Saprolegnia* on a chemically defined medium.

The crucial step in our culture technique was the separation of fungi from bacteria. Preliminary studies showed that bacteria readily outgrew the water molds on Reischer's liquid medium. However, we did not favor the use of antibiotics. Instead decontamination was achieved quite simply by employing SPS agar in Raper's ring technique.

Since the SPS agar is chemically defined and supports the production of sexual structures and the germination of oospores in *Saprolegnia*, the authors suggest the use of this medium in place of hempseeds for the culture of these fungi. Furthermore, this medium is particularly applicable in studies requiring controlled cultural conditions as well as the maintenance of stock cultures of *Saprolegnia*. Presently all stock cultures of saprolegniaceous fungi in this laboratory are being maintained on 2% quarter-strength SPS agar.

SUMMARY

Eight species of *Saprolegnia* were established in pure culture on a chemically defined medium and produced antheridia, oogonia, and mature oospores. Preparation of the medium and culture techniques were described.

LITERATURE CITED

- Bhargava, K. S. 1945. Physiological studies on some members of the family Saprolegniaceae. III. Nitrogen requirements. Jour. Indian Bot. Soc., 24:67-72.
- Johnson, T. W., Jr. 1956. The Genus *Achlya*: Morphology and Taxonomy. 180 pp., 22 pls. Univ. Michigan Press, Ann Arbor, Mich.
- Raper, J. R. 1937. A method of freeing fungi from bacterial contamination. Science, 85:342.

- Reischer, H. S. 1951. Growth of Saprolegniaceae in synthetic media. I. Inorganic nutrition. *Mycologia*, 43:142-155.
- Scott, W. W. 1961. A Monograph of the Genus *Aphanomyces*. Va. Agric. Exp't. Sta. Bull. 151, 95 pp., 9 pls.
- Scott, W. W., and A. H. O'Bier. 1962. Aquatic fungi associated with diseased fish and fish eggs. *Prog. Fish-Cult.*, 24:3-15.
- Volkonsky, M. 1933. Sur l'assimilation des sulfates par les Champignons: Euthiotrophie et Parathiotrophie. *Compte Rendus Acad. Sci. Paris*, 197:712-714.
- Whiffen, A. J. 1945. Nutritional studies of representatives of five genera in the Saprolegniaceae. *Jour. Elisha Mitchell Sci. Soc.*, 61:114-123.

SOME NEW AND UNUSUAL FUNGI FROM VIRGINIA. II. AQUATIC HYPHOMYCETES

William W. Scott and Clyde J. Umphlett

Virginia Polytechnic Institute

and

The University of North Carolina

(Received for publication July 26, 1962)

The aquatic fungi are usually regarded as members of eight or nine zoosporic orders of Phycomycetes. There are, in addition, certain adventitious inhabitants of the aquatic environment. One such group, the so-called "aquatic Hyphomycetes", grow completely submerged within the skeletonized tissues of angiosperm debris and complete their entire life-cycles beneath the surface of the water. A search for species of aquatic Hyphomycetes occurring in southwestern Virginia immediately revealed their abundance. Fifteen species representing twelve different genera are reported herein.

FUNGI COLLECTED

Clavariopsis aquatica de Wildeman. Ann. Soc. Belge Microsc., 19: 197. 1895. (Plate VI, fig. 8,A). Although generally regarded as a common species by other investigators (Ingold, 1942; Ranzoni, 1953), such was not the case during this study. The distribution and occurrence of *C. aquatica* did not approach the frequency of several other species. It was observed occasionally on collections of submerged leaves from only 5 of 12 collection sites in Montgomery County, Virginia.

The spores of *C. aquatica* are tetra-radiate and are attached by the tip of one of the four arms. They develop as swollen club-like structures cut off from the hyphae by cross-walls. Three processes arise and elongate simultaneously. During the development of these radiately divergent arms the original primordium is bisected by a septum. At maturity the appendages measure 29-74 μ in length, 2-3 μ in diameter, and the attached arm, measures 29-42 μ in diameter. The mature spore is liberated soon after its formation by a rapid disarticulation at the basal septum. The liberated conidium, with one thick arm and three slender arms, is readily recognizable. The spore-producing capacity of the sporophore is not limited to the production of a single conidium. Following a short period of apical elongation another conidium may develop in a manner identical with that described above. Germination of the conidium occurs readily in

water. A single germ tube is produced from the tip of each radiating arm.

Heliscus tentaculus Umphlett. Va. Jour. Sci., 10: 27. 1959. [Plate V, fig. 7, A-J). This is the largest and most elegant of the species of *Heliscus* yet described. It was found first on submerged and decaying leaves of *Platanus occidentalis* in Mill Creek, Montgomery County, Virginia, and later on *Fagus grandifolia* from the same site. Since that time *H. tentaculus* has been reported by Hudson (1960) from Jamaica and was observed again several times from Virginia at sites on Tom's Creek and from the North Branch of the Roanoke River in Montgomery County. This species never occurs in abundance and growth is sparse. Usually a dozen sporophores or fewer are observed in any one collection.

Species of *Heliscus* undergo sporogenesis in a manner similar to that described for *Clavariopsis aquatica* except that one or more phialides are produced at the apex of the sporophore from which the conidia develop. The sporophores with phialides and conidia are very conspicuous by their size oftentimes reaching a total length of 225 μ . As in *C. aquatica* three divergent arms develop simultaneously from the swollen apex of a fourth attached arm and at maturity are 33-43 μ in length and 1.5-2.0 μ in diameter, at maturity. Conidia are liberated from the phialides by a gradual disarticulation at the basal septum. Spore formation usually continues from the apex of the old phialide. Germination of the conidium occurs by the formation of germ tubes from the basal portion of the spore and from each divergent arm.

The discovery and description of *H. tentaculus* lends further support to the suggestion originally proposed by Ingold and Cox (1957) for the erection of a new genus to include *H. tentaculus*, *H. stellatus*, and *H. longibrachiatus*.

Heliscus stellatus Ingold and Cox. Trans. British Mycol. Soc. 40: 155. 1957. Conidia resembling those described for *H. stellatus* were observed once from a collection of debris found floating in a backwash on Tom's Creek, Montgomery County, Virginia. These spores were tetra-radiate with three short divergent arms and a basal cell of somewhat wider diameter. However, there was no way of knowing whether or not the spores observed had been produced on phialides.

Tetrachaetum elegans Ingold. Trans. British Mycol. Soc., 25:377. 1942. (Plate IV, fig. 6, N-J). This fungus appeared most frequently in collections made during the autumn and early winter, and was observed occasionally from spring and summer collections. It was often observed in great abundance on decaying leaf margins. Like the previously described species, *T. elegans* produces a tetra-radiate conidium attached to the conidiophore by one of four divergent arms.

In this species the conidium originates as a long, straight primordium cut off by a septum about $100\ \mu$ from the apex. Two lateral protuberances arise behind the growing apex of the spore primordium. As the lateral arms elongate, the main axis continues to grow and to bend away from the divergent branches. At maturity the main axis, continuous with the sporophore, may reach a length of $200\text{--}278\ \mu$, and each of the radiating arms may measure $94\text{--}140\ \mu$ in length and $2\text{--}3\ \mu$ in diameter. As the arms of the spore develop, a second septum develops in the main axis about $5\text{--}7\ \mu$ above the first. The resulting cell may be termed a "separation cell" since its rupture serves to release the conidium from the sporophore. A portion of the separation cell always remains attached to the base of the conidium in the form of a collar, a phenomenon which also occurs in *Anguillospora longissima*. The large and spidery spores of *T. elegans* are very characteristic and readily identifiable. Germination of the conidia occurs readily on agar or in water. Usually a very slender germ tube develops from the tip of each arm of the spore.

Alatospora acuminata Ingold. Trans. British Mycol. Soc., 25:384. 1942. (Plate IV, fig. 6, A-C). This is one of the most frequently encountered species during autumn and spring months. It was found to sporulate in nature during the winter, a condition most unusual among aquatic Hyphomycetes.

Conidia of *A. acuminata* develop at the apices of phialides. These are produced singly or, less often, two or more at the tips of short sporophores. The rather small conidia develop almost exactly like the species previously described. The spore is initiated as a slender outgrowth from the phialide. Apical elongation occurs, two lateral arms develop, the main axis continues to elongate and bends away from the developing divergent processes. The main axis attains a length of $20\text{--}30\ \mu$ and the arms at maturity measure $19\text{--}32\ \mu$ in length and $2.3\text{--}3.0\ \mu$ in diameter. There is no separation cell formed as described for *Tetrachaetum elegans*. At maturity a septum is formed delimiting the conidium from the phialide. A succession of spores may be produced from the same phialide.

There is a striking similarity in the appearance and development of the spores in this genus and those observed for the preceding genera. *Alatospora acuminata* can be regarded as the phialospore equivalent of *Tetrachaetum elegans* just as *Heliscus tentaculus* and *H. stellatus* may be regarded as the phialospore equivalent of *Clavariopsis aquatica*.

Articulospora tetracladia Ingold. Trans. British Mycol. Soc., 25:376. 1942. Although generally regarded as a common species, *A. tetracladia* was collected only one time during this survey. It was observed among stream flora collected in a backwash on the North Branch of the Roanoke River, Montgomery County, Virginia.

In *A. tetracladia* branched sporophores are produced; and, unlike the type of sporogenesis exhibited by the species previously described, the four arms produced develop in succession. Several conidia at different stages in their development may be formed at the tip of each sporophore. At the point where each of the three divergent arms is inserted on the first-formed arm of the conidium, a marked constriction occurs. This feature and the fact that the first-formed arm is usually much shorter than the others, makes the liberated spore readily identifiable.

Tetracladium marchalianum de Wildeman. Ann. Soc. Belge Microsc. 17:35. 1893. (Plate III, fig. 5, A-H). This species has proved to be one of the most abundant members of the aquatic Hyphomycetes. It has been found on a wide variety of substrata, including a piece of discarded and submerged newspaper, and from every collection site.

As in *Articulospora tetracladia*, the four arms of the conidium develop in succession. In addition to these each conidium develops two knob-like structures. The sporophores are usually simple and may produce at their apices two or three conidia in different stages of development. At maturity the four divergent arms measure 20-52 μ in diameter at the base. Each arm tapers toward the apex and becomes septate. The two subspherical knobs measure 6-9 μ in length and 4-6 μ in diameter. One knob is situated in the axil of the four divergent branches, the other is located on the upper surface of one branch a short distance from the point of its insertion. Germination of the conidium occurs readily in water. In most cases slender germ tubes are formed at the tips of each branch and occasionally from the knob-like protuberances.

Tetracladium setigerum (Grove) Ingold. Trans. British Mycol. Soc., 25:369. 1942 (Plate VI, fig. 8, B). During this survey free-floating spores of *T. setigerum* were observed frequently; but only occasionally has it been observed growing and sporulating on submerged vegetable debris. This species differs from *T. marchalianum* in that the knobs characteristic of the latter, are replaced by three finger-like projections. All of the spore arms are strongly and abruptly tapered.

Sporogenesis occurs in a manner quite similar to that described for the previous species. At maturity each of the four divergent arms measures 25-35 μ in length and 3 μ in basal diameter tapering to 1 μ at the apex. The three parallel finger-like projections measure 12-5 μ in length and 3-4 μ in diameter. Spore germination occurs as in *T. marchalianum*.

Tricladium angulatum Ingold. Trans. British Mycol. Soc., 25:389. 1942. (Plate I, fig. 2, A-H). This species was one of the less frequently encountered members of the aquatic Hyphomycetes. It was never observed in abundance although, during the winter months, almost every collection contained a few isolates.

Two or three conidia in various stages of development are usually found at the apex of each sporophore. The latter may or may not be branched. The conidium is large, multicellular, with a main axis measuring 33-55 μ in length and 3-4 μ in diameter twisted and tapering to 2-3 μ at the apex, and with two lateral divergent branches 20-30 μ in length inserted on the main axis 10-15 μ apart and located in different planes. The spores are oftentimes pearly in appearance due to an accumulation of reserve glycogen.

Tricladium gracile Ingold. Trans. British Mycol. Soc., 27:30. 1944. (Plate IV, fig. 8, C). *T. gracile* is another species of very infrequent occurrence. During this survey it was observed only three times and from only two of twelve collecting sites.

Although sporogenesis is similar to that found in *T. augulatum*, certain differences warrant the separation of the two species. In *T. gracile* the conidia are borne singly and the lateral branches are of a uniform diameter, not tapering as in *T. augulatum*. Furthermore, the spores of this species are considerable larger, the main axis measuring 95-132 μ in length and 3-4 μ in diameter with two lateral branches 50-90 μ in length and 1.5 μ in diameter.

Lemonniera aquatica de Wildeman. Ann. Soc. Belge Microsc., 18:143. 1894. (Plate II, fig. 3, A-G). Unlike the species previously described, the spores of *L. aquatica* are attached to the tip of the sporophore at a point near the divergence of the four arms. It is of very common occurrence in Virginia.

The sporophores of *L. aquatica* are comparatively long, measuring 123-250 μ . At the apex several phialides are produced. The spore is initiated as a spherical swelling at the end of a phialide. From it four protuberances arise and elongate simultaneously, producing four arms 39-58 μ in length and 4 μ in diameter. The branches may become sparingly septate at maturity.

Triscelophorus monosporus Ingold. Trans. British Mycol. Soc., 26: 152. 1943. (Plate II, fig. 4, A-G). This fungus was one of the most common species encountered during the present survey. Like the preceding species the conidium is attached to the sporophore at a point near the divergence of the four arms.

Sporogenesis, unlike that described for *Lemonniera aquatica*, involves the development of four divergent arms in succession rather than simultaneously. Furthermore the conidia are produced directly at the apex of the sporophore, not on phialides. At maturity the main axis of the spore is two celled, 44-55 μ in length and 3-3.5 μ in basal diameter tapering to 1-1.5 μ at the apex. The three divergent branches arise from the basal cell

of the main axis and are 26-36 μ in length and 2-3 μ in diameter tapering to 1-1.5 μ at the apex.

Campylospora chaetocladia Ranzoni. Farlowia 4: 373. 1953. (Plate VI, fig. 8, D). This unusual fungus with a type of spore development unlike that of any other aquatic Hyphomycete was observed only once during the present survey. It was found growing and sporulating on the submerged bark of *Platanus* from a single collection site.

The conidium is produced singly on a simple unbranched sporophore. The spore initial is at first oval but becomes elongate and bent like a campylotropous ovule. At the apex of this short bent axis a lender branch develops. Three similar branches arise from the axis in a divergent manner near the point of attachment to the sporophore. At maturity the spore arms measure 34-45 μ in length and 3-5 μ in diameter tapering to 1.5 μ .

Anguillospora longissima (Saccardo and Sydow) Ingold. Trans. British Mycol. Soc., 25: 308. 1942. (Plate III, fig. 5, I-O). The conidia produced by the several species described above constitute the majority of the aquatic Hyphomycetes and are either tetra-radiate or otherwise branched. Several species including *A. longissima* produce conidia of a more conventional type. In this species the spore is born singly on a long sporophore 50-150 μ in length. The conidium is falcate or sigmoid, scolecosporous, 150-350 μ in length and 5-6 μ in diameter at the mid-point tapering to 2.5-4.0 μ at the tips. At maturity the spore is multicellular. Discharge is accomplished by the rupture of a specialized separation cell at the apex of the sporophore.

Lunulospora curvula Ingold Trans. British Mycol. Soc., 25: 404. 1942. (Plate I, fig. 1, A-H). *L. curvula* is another species with a simple conidium. These are unicellular, lunate or sigmoid, 63-113 μ in length, 4-5 μ in diameter at the mid-point and tapering to 1-2 μ at the tips. Spores are released by the rupture of a specialized stalk cell.

SUMMARY

Fifteen species representing twelve genera of aquatic Hyphomycetes are reported from collection sites in southwestern Virginia. Members of the genera *Clavariopsis*, *Heliscus*, *Tetrachaetum* and *Alatospora* produce tetra-radiate conidia attached to the sporophore by the tip of one of the four arms. Furthermore, the three divergent arms develop simultaneously. *Heliscus* may be regarded as the phialospore equivalent of *Clavariopsis* and *Alatospora* the phialospore equivalent of *Tetrachaetum*. Members of the genera *Articulospora*, *Tetracadium* and *Tricladium* produce tetra-radiate spores attached in the same manner. In these genera, however, the three divergent spore arms develop simultaneously. *Lemonniera*, *Triscelophorus*, and *Campylospora* represent genera whose members produce tetra-radiate

spores attached to the sporophore near the point of divergence of the four arms. *Anguillospora* and *Lunulospora* are genera whose members produce simple, unbranched conidia.

LITERATURE CITED

- Hudson, J. J. 1960. Aquatic Hyphomycetes from Jamaica. Trans. Brit. Mycol. Soc., 43: 469-478.
- Ingold, C. T. 1942. Aquatic Hyphomycetes of Decaying Alder Leaves.
- Ingold, C. T. 1942. Aquatic Hyphomycetes of Decaying Alder Leaves. Trans. Brit. Mycol. Soc., 25: 339-417.
- Ingold, C. T. 1958. Aquatic Hyphomycetes from Uganda and Rhodesia. Trans. Brit. Mycol. Soc. 41: 109-114.
- Ingold, C. T. and V. J. Cox. 1957. *Heliscus stellatus* sp. nov., an Aquatic Hyphomycete. Trans. Brit. Mycol Soc., 40: 155-158.
- Ranzoni, F. V. 1953. The Aquatic Hyphomycetes of California. Farlowia, 4: 353-398.

EXPLANATION OF PLATE I

Fig. 1, A-H. *Lunulospora curvula* Inc., showing sporogenesis.. A. Tip of an aleuriophore showing a spore primordium on a stalk cell, 8:55 P. M. B. Note the initiation of the basal growing point on the spore primordium, 9:45 P. M. C. A new spore initial has appeared on the same sporophore, 10:20 P.M. D. The same spores at 10:50 P.M. E. The young spore primordium has become distinctly clavate, and the aleuriospore on the left is nearly mature, 11:20 P.M. F. The mature spore has been released, and the stalk cell of the spore primordium on the right has been differentiated, 11:55 P.M. G. The same spore at 12:45 A. M. H. Note the new spore initial forming on the left, 1:35 A. M.

Fig. 2. A-H. *Tricladium angulatum* Inc., showing sporogenesis. A. Tip of an aleuriophore showing a nearly mature aleuriospore on the right, and a young spore primordium on the left, 10:40 A.M. B. The spore on the right has been liberated, and a septum has cut off the spore primordium from the sporophore, 11:40 A.M. C. Note the distinct curvature of the main axis of the spore primordium, and the formation of a second septum, 12:45 P.M. D. A branch initial has appeared below the second septum, 1:45 P.M. E. A third septum has formed, 2:20 P.M. F. Note the appearance of the second branch initial, 3:50 P.M. G. The same spore at 5:00 P.M. H. The mature aleuriospore just prior to release, 6:55 P.M.

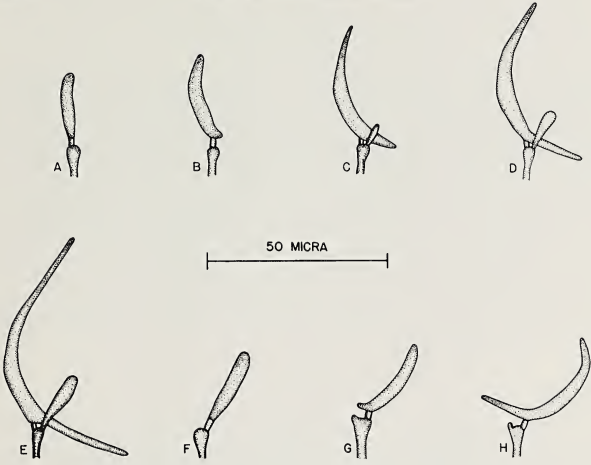


FIG. 1

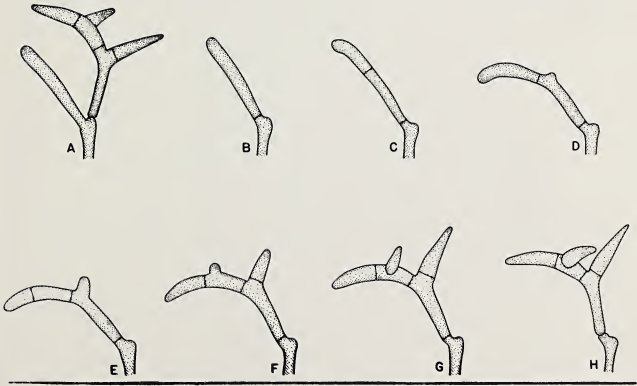


FIG. 2

EXPLANATION OF PLATE II

Fig. 3, A-G. *Lemonniera aquatica* de Wild., showing sporogenesis. A. Tip of a sporophore terminated by two phialides; the left phialide sears an immature phialospore, and a spore has just been liberated from the phialide on the right, 3:15 P.M. B. The spherical spore primordium has formed on the right, 4:35 P.M. C. The spore primordium has become noticeably tetrahedral, 6:00 P.M. D. The spore on the left has matured and has been released; the terminus of the primordium on the right has begun to elongate, 8:15 P. M. E. A spherical spore primordium has been initiated on the left, and the four arms of the immature spore on the right continue to elongate, 9:15 P.M. F. The same spores at 12:30 A.M. G. The spore on the right just prior to liberation; the branches of the spore on the left have begun to elongate, 2:00 A.M. From a hanging-drop culture on a leaf of *Quercus* sp.

Fig. 4, A-G. *Triscelophorus monosporus* Inc., showing sporogenesis. A. The swollen tip of the sporophore has been cut off by a septum to form the spore primordium, 7:40 P.M. B. A septum has formed dividing the spore primordium into a basal cell and a terminal cell, 8:10 P.M. C. Initiation of the first lateral branch from the limoniform cell, 8:50 P.M. D. Initiation of the second lateral branch as elongation of the first continues, 10:40 P.M. E. The third lateral branch has appeared, 1:00 A.M. F. The same spore at 2:45 A.M. G. The mature aleuriospore just prior to release, 3:50 A.M. From a hanging-drop culture on a leaf of *Platanus occidentalis*.

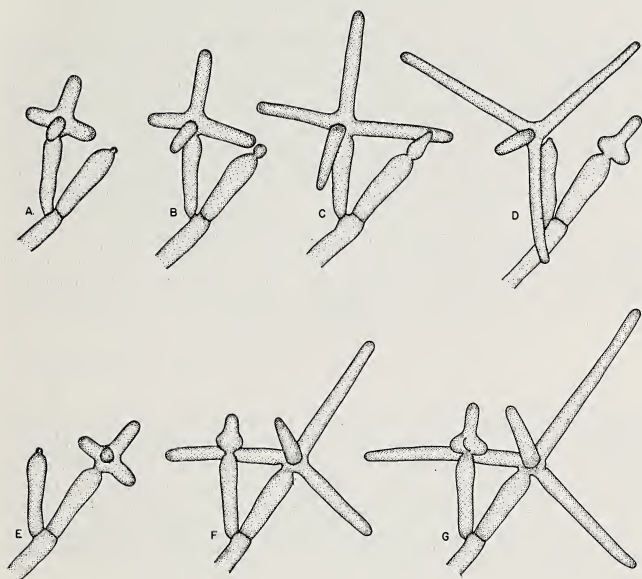


FIG. 3

50 MICRA

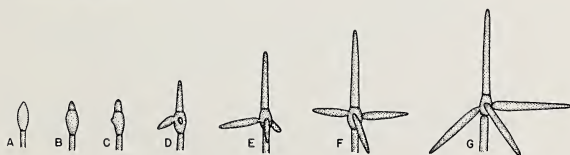


FIG 4

EXPLANATION OF PLATE III

Fig. 5, A-H. *Tetraccladium marchalianum* de Wild., showing sporogenesis. A. The tip of a sporophore bearing a mature aleuriospore, and two immature spores, 11:20 A.M. B. The mature spore has been released, leaving the clavate spore primordium on the left, and the developing spore on the right, 12:35 P.M. C. The apex of the spore primordium has been cut off by a septum forming the apical knob, 3:30 P.M. D. The aleuriospore on the right is being liberated, 4:00 P.M. E. A lateral growing point has appeared below the septum, 4:50 P.M. F. A second lateral branch initial has appeared, 7:00 P.M. G. A septum has formed cutting off the tip of the first branch initial thus forming the second knob of the spore; below this septum a lateral protuberance has developed which will form one of the divergent branches of the spore; note that a third branch has developed from below the first septum, 8:30 P.M. H. The nearly mature aleuriospore, 11:20 P.M. From a hanging-drop culture on a leaf of *Quercus* sp.

Fig. 5, I-O. *Anguillospora longissima* (Sacc. and Syd.) Inc., showing sporogenesis. I. The slightly clavate tip of an aleuriophore, 10:10 A.M. J. The tip has been separated from the sporophore by a septum forming the spore primordium, 10:55 A.M. K. Two more septa have formed below the first septum thus forming a separating cell, 3:30 P.M. O. The mature aleuriospore just after liberation; note the collars on the base of the spore and the apex of the sporophore, 4:05 P.M. From a hanging-drop culture on a leaf of *Magnolia* sp.

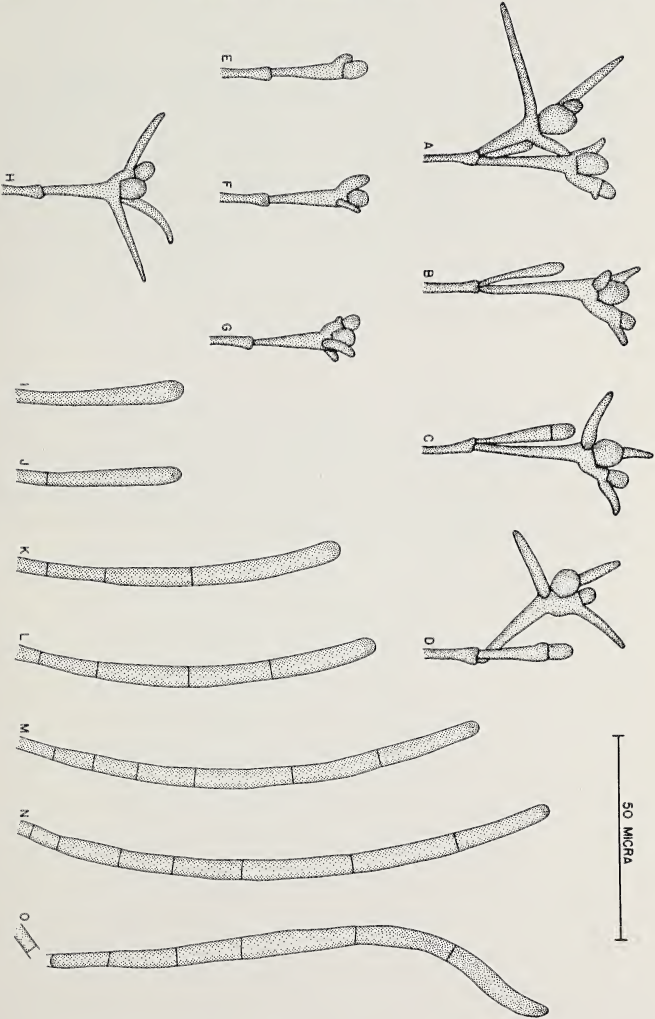


FIG. 5

EXPLANATION OF PLATE IV

Fig. 6, A-G. *Alatospora acuminata* Inc., showing sporogenesis. A. A sporophore terminated by two phialides; the phialide on the left bearing an immature phialospore, and on the right is a mature spore just prior to release, 7:00 P.M. B. The spore at right has been liberated, and a new spore primordium has appeared; the spore on the left is nearly mature, 8:10 P.M. C. The spore on the left has been released, 8:50 P.M. D. Note the curvature of the spore primordium on the right, 10:20 P.M. E. Two lateral, divergent branch initials have differentiated on the spore on the right, and a new spore primordium is developing from the phialide on the left, 11:15 P.M. F. The same spores at 12:55 A.M. G. The mature spore on the right just prior to liberation, 2:45 A.M. From a hanging-drop culture on a leaf of *Platanus occidentalis*.

Fig. 6, H-J. *Tetrachaetum elegans* Inc., showing spores in different stages of development. H. A slightly clavate spore primordium at the tip of a sporophore. I. A spore showing the apex of the main axis which has become bent upon the formation of the two branch initials; note also the formation of the separating cell at the base of the spore. J. The mature aleuriospore just prior to release by rupture of the separating cell. From a hanging-drop culture on a leaf of *Acea* sp.

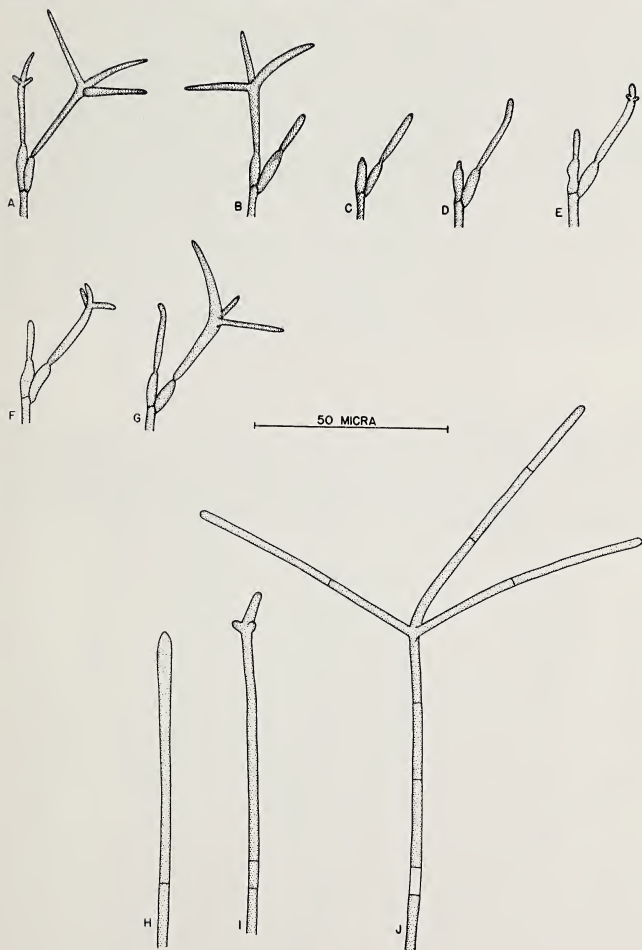


FIG. 6

EXPLANATION OF PLATE V

Fig. 7, A-G. *Heliscus tentaculus*, N. sp., showing sporogenesis. A. Tip of a sporophore showing two phialides; on the left phialide is a spore primordium which has become clavate, and on the right is a very short linear extension from the phialide, 11:50 A.M. B. Three branch initial have developed on the left, 12:05 P.M. C. The same spores at 1:05 P.M. D. The spore on the left is being liberated, and the spore initial on the right continues to elongate, 4:00 P.M. E. The spore primordium on the right has become clavate, 4:30 P.M. F. Two of the three divergent branches are visible, the other is behind the swollen tip of the spore 5:30 P.M. G. A septum has formed at the junction of the mature spore and the phialide; liberation of the phialospore will occur at that point; the the spore initial on the left has begun to elongate, 6:15 P.M. From a hanging-drop culture on a leaf of *Platanus occidentalis*.

Fig. 7, H-J. *Heliscus tentaculus*, n. sp. H. The tip of a sporophore showing three phialides with spores each of which is in a different stage of development. I. An abnormal spore with only two divergent branches. J. An abnormally functioning phialide producing a curved, filiform hypha instead of a typical phialospore. From a hanging-drop culture on a leaf of *Platanus occidentalis*.

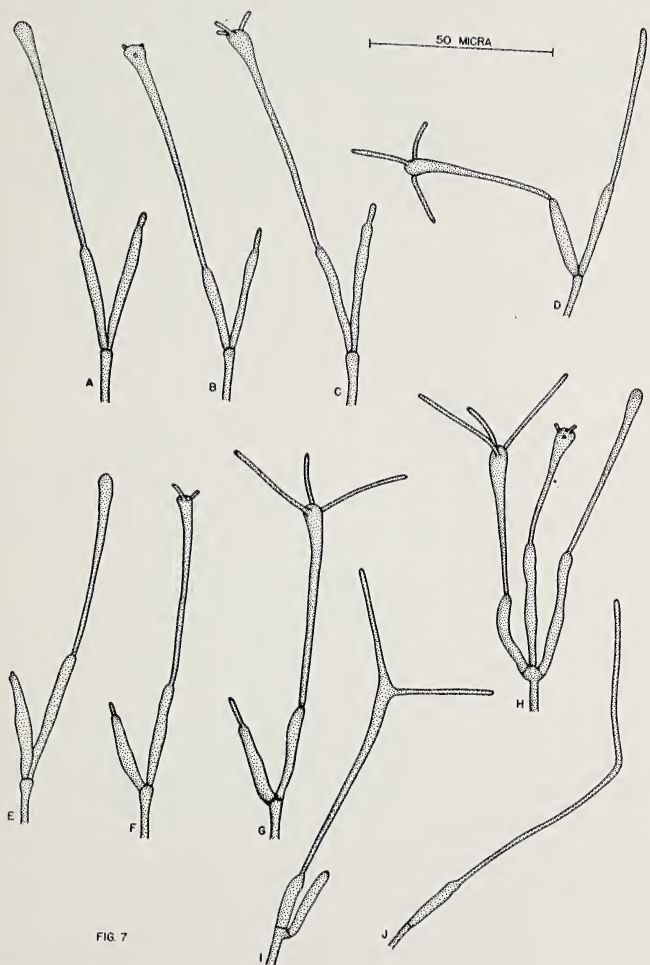


FIG. 7

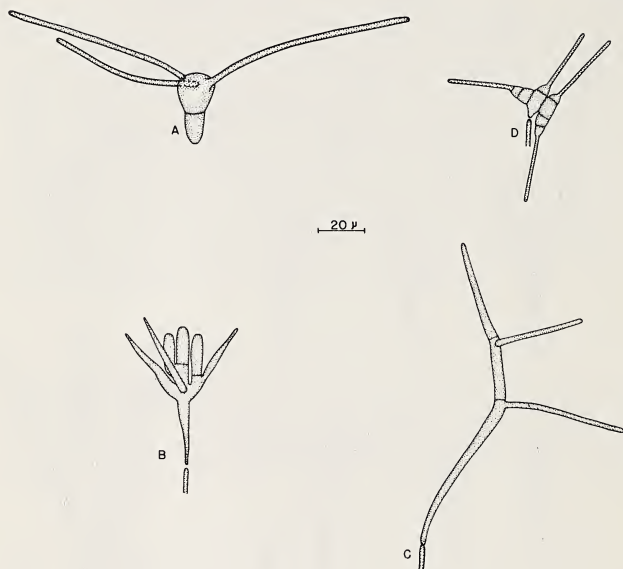


FIG. 8

EXPLANATION OF PLATE VI

- Fig. B, A. *Clavariopsis aquatica* de Wild., showing a mature aleuriospore.
 B. *Tetracladium setigerum* (Grove) Inc., showing a mature aleuriospore.
 C. *Tricladium gracile* Inc., showing a mature aleuriospore.
 D. *Campylospora chaetocladia* Ranz., showing a mature aleuriospore.
 All from temporary water mounts of individual spores formed on decaying leaves in water.

News And Notes

News contributions may be sent to any of the Section Editors or to the Editor.

Change of address notification should be sent promptly to Carl W. Allen, Managing Editor, Virginia Journal of Science, Virginia Polytechnic Institute, Blacksburg, Virginia. Give both old and new address.

1963 MEETING OF THE ACADEMY

The Forty-first Annual Meeting of the Virginia Academy of Science will be held in Roanoke. The Hotel Roanoke will be the headquarters hotel. Room rates are: singles, \$8-10; doubles, \$13-16; suites, \$28-32. The Program of the meeting may be found in this issue.

MINUTES OF THE COUNCIL MEETING

Newcomb Hall, University of Virginia, November 3, 1962.

The meeting was called to order by President J. J. Taylor at 1 p.m. Those attending were F. Smith, W. Scott, J. Calver, E. Brand, J. Grayson, H. Hobbs, Isabel Boggs, P. Siegel, P. Hansen, G. Miller, Jr., S. Row, R. Hughes, B. Harshbarger, W. Hinton, E. Turner and W. Wartman, Jr. Minutes of the last meeting were approved as published.

Report of officers. President. Mr. Taylor received an invitation to attend the Southeastern Regional Leadership Conference on Action for Mental Health. He proposed that, with Council's consent, he not attend. Council concurred. He requested the secretary to check Academy records and report any discrepancies in the published Constitution and By-laws (Proceedings 1961-1962).

Treasurer—Due to other pressing duties Mr. Berry has requested Mr. Smith to temporarily continue with the Treasurer's duties. Mr. Smith has done this, and at Dr. Hobb's suggestion, Council thanked Mr. Smith.

Mr. Smith reported that there was a balance of approximately \$5,000 in the General Fund and that \$1,600 was available for research grants. Dr. Harshbarger pointed out the market value of the Academy's invested funds had decreased only 11% in the March to September, 1962 period, which was considerably lower than the decrease of many investment funds, and tended to justify the conservative nature of the investments.

COMMITTEE REPORTS

Trustees—This report was given by Mr. Smith and was included in the Treasurer's report.

Research—Dr. Hughes reported that to date two applications for research grants had been received totaling \$600. He anticipates requests will exceed available research funds.

Finance & Endowment — Dr. Harshbarger reported that no report would be given at this time. A report will be given after consulting with the Treasurer.

Long Range Planning — In Dr. Leidheiser's absence Mr. Taylor distributed copies of this report, which included six recommendations and actions. After considering this report Council took action as follows: 1. A motion was passed that committee chairmen and section chairmen receive copies of minutes of Council meetings at the same time they are distributed to Council members. 2. The Committee suggested that an aggressive effort be made to attract industrial research people, particularly senior management people, into Academy membership. A motion was passed that this suggestion be referred to the Membership Committee for its consideration. 3. The Committee asked Council to consider if there be a means more representative of a cross section of the Academy, for nominating officers than that presently practiced, which usually consists of the three past presidents as a nominating committee. In this discussion it was pointed out that the president may appoint others to the Nominating Committee if he elects to do so, and also that when elections are held nominations may be made from the floor. Council passed a motion that this request of the Committee be referred to the Nominating Committee for its consideration. 4. The Committee noted that the question of an Executive Secretary for the Academy is now in the hands of the Council for action. The Committee reported that it stands ready to accept any assignment by Council arising from the matter. In the discussion it was brought out that Council is investigating this matter and no formal action was indicated at this time. 5. The Committee recommended that Council implement a means for achieving year-round publicity on Academy matters, particularly within the state and publicizing that the Academy is representative of a cross-section of scientific disciplines. Council passed a motion that the Academy President be requested to implement the spirit of this recommendation and make contacts as suggested by the Committee. 6. The Committee asked Council to consider the possibility of getting support from the state and/or industry to make a survey of research facilities and scientific manpower within the state. In the discussion there were questions raised as to the need for such a survey, the possible duplication

of efforts of national and state surveys, and just now the Academy would proceed in making such a survey. Dr. Harshbarger reported that the state had considered making such a survey and discussions have been held with certain V.P.I. personnel. He thought that the Academy would benefit from participating and recommended that the Academy offer to assist in the project. A motion was passed that the Virginia Academy of Science offer to act as a co-sponsor with V.P.I. in preparing a brochure of Scientific Manpower in the State of Virginia.

Membership — The Assistant Secretary-Treasurer gave the Membership report for Mr. Harlow. The Committee is following the same procedures used last year, which were successful in obtaining both individual and business members.

Natural Resources — The report was read by Mr. Taylor. In this report it was recommended that the President of the Academy offer the services of the Academy in assisting state authorities in developing natural resources within the state. The President reported that he had made such an offer to the Governor in a letter this fall.

Awards — A special committee to consider the matter of the Academy recognizing an industrial firm for contributing to scientific progress in the state recommended that the Academy establish an appropriate award, the recipients to be selected by the Awards Committee. It recommended that the special committee be discharged. A motion was passed that the report be accepted and the Awards Committee be requested to study the recommendation and report to Council as to whether such an award is advisable.

Virginia Flora — In Dr. Massie's absence, Mr. Taylor read this report. Several groups are actively studying and classifying the flora of Virginia.

Junior Academy of Science — Dr. Scott's report showed that Junior Academy's activities are well under way. The first issue of the Junior Academy Bulletin is in publication. Some former Junior Academy members, now in college and universities, feel that there is a need for a collegiate academy program and Council asked to consider the possibility of such a program. As a result of recommendation of this committee Council took the following actions:

1. Empowered the Finance Committee, if funds are available, to allocate \$100.00 for the expenses of three Junior Academy members and Dr. Scott in attending the AAAS meeting in December at Philadelphia. Three outstanding students were invited to present ten minute project reports at the meeting.
2. Requested the Finance Committee to consider if means could be found to finance at approximately \$100.00 the publication of a Junior Academy of Science Brochure being edited by Mark Salzberg, a

student at Norfolk Academy. 3. Requested the Finance Committee to consider possible financing for sending two students, their two science sponsors, and Dr. Scott to a National Science Seminar to be held in conjunction with the National Science Fair May 6-12, 1963 in Albuquerque, New Mexico. 4. Approved the application for a National Science Foundation grant to support the work of the Junior Academy. The amount to be requested is \$40,326 to be used over a three year period. Since the deadline date for submission was October 15, 1962, the application had been tentatively submitted, subject to Council approval. These funds would be in addition to the normal Junior Academy funds.

History of Science — Miss Boggs reported that the manuscript "A History of the Virginia Academy of Science" is ready for publication. The Virginia Institute for Scientific Research, Longwood College, and Randolph-Macon Woman's College have contributed to its preparation, the only expense involved being \$50.00 for stenographic help. Council authorized the Treasurer to reimburse the Committee \$50.00 for this expense. Council also moved that the Academy authorize "A History of the Virginia Academy of Science" as an Academy publication. Dr. Boggs also reported that the Virginia Institute for Scientific Research has kindly offered space for storing the archives of the Virginia Academy of Science. The Committee recommended that the archives include bound volumes of Academy Proceedings and of Claytonia, and asked Council to authorize the cost (approximately \$100.00) of binding these volumes. Council asked the Finance Committee to look into the matter.

Science Talent Search — Dr. Scott, reporting for Mr. Russell, said Science Talent Search activities are proceeding satisfactorily.

Virginia Journal of Science — Dr. Siegel reported that publication is on schedule. The V.P.I. library has kindly consented to temporarily store the back issues of the Journal. Proofreading for the proceedings issues is being done by section editors.

Place of Meeting — Dr. Miller, President of Madison College, through Col. Heflin, has invited the Academy to meet there in 1966. Formal action on the request must be taken at the 1963 meeting but a motion was passed that Dr. Miller be extended thanks for the invitation and notified that Council would recommend to the membership that the invitation be accepted.

Other Business — Plans for a symposium to be held at the 1963 meeting are still tentative, and Council passed a motion that the Executive Committee of the Academy be empowered to act for the Council if there be need for action prior to the next Council meeting.

After reviewing records of Council Meeting minutes Dr. Patterson

reported (via Mr. Wartman) that, based on original intent, the E. C. L. Miller Award should be given to the winning Science Club, and not to the club sponsor.

A motion was passed that the President of the Academy distribute a summary of deadlines and dates to interested parties.

Dr. Hughes, suggested that in the future the Finance Committee be notified in advance of any requests for additional funds to be presented at Council meetings.

Mr. Taylor stated that the next Council meeting would be held about the middle of March, 1963, in Charlottesville, the exact date to be announced at a later time.

The meeting was adjourned.

William B. Wartman, Jr., *Asst. Secretary-Treasurer*

FROM THE SECTIONS

Dr. Sidney S. Negus, retired Chairman of the Biochemistry Department at M.C.V., has been cited by the National Association of Science Writers, "for his contribution over the past quarter of a century in bettering the public understanding of science." Dr. Negus has acted as an intermediary between scientists and the press at numerous scientific meetings.

On February 8th, the Blue Ridge Psychological Association and Chowder and Marching Society held its irregular winter meeting. Master of ceremonies F. J. McGuigan, Chairman of the Department of Psychology of Hollins College, announced that a spring meeting will be held. The speaker of the evening was Dr. Roy Lachman of Hollins College. His presentation of "Disaster Behavior in Hawaii" was a report on portions of his research on the behavior of volcano eruption victims. A new field of study—geopsychology or psychogeology—would seem to offer interesting possibilities for psychologically oriented geologists or geologically oriented psychologists who happen to be present at the time volcanic eruptions occur.

The Lynchburg Public Schools have appointed a new School Psychologist, Mrs. Bede Pantaze, most recently a member of the psychology staff at Lynchburg Training School and Hospital.

The International Committee on Bacteriological Nomenclature has organized some new Subcommittees at the recent 8th World Congress, among these a Subcommittee on Lactobacilli of which Dr. P. A. Hansen, a Section Editor of the Journal, was elected Secretary.

Quality



Products of *The American Tobacco Company*

© A. T. Co.

"Tobacco IS OUR MIDDLE NAME"

James A. Faiszt has been appointed Associate Professor of Landscape Design in the Department of Horticulture at V.P.I. Mr. Faiszt came to V.P.I. from Louisiana State University.

Dr. D. G. Cochran and Dr. J. M. Grayson of the V.P.I. Entomology Department, have been awarded a grant of \$56,258 from the National Institutes of Health for a 5-year period in support of studies on insect resistance to insecticides. The grant replaces a 3-year grant from N.I.H. for the same type of study.

The Department of Plant Pathology and Physiology of the Virginia Polytechnic Institute, is now offering a graduate program leading to the Ph.D. degree. Areas of specialization are diseases of agronomic and horticultural crops, physiology and genetics of disease resistance, physiological action of herbicides, plant growth regulators, and plant nutrition. The department has 25 staff members whose training makes possible the offering of courses of study over a wide field of plant pathology and physiology.

Announcement has been made by V.P.I. of a National Science Foundation grant for summer science training programs in agricultural life sciences and in statistics. The two programs will run concurrently from June 16 to July 27, 1963. The programs are designed to challenge high school students who have completed eleven years of school. Students interested in applying for either of these summer science training programs must apply by writing to Dr. Whitney L. Johnson, Director of Statistics Training Program, or to Dr. T. J. Horne, Director of Resident Instruction.

The Virginia Association of Professional Geologists, which was formed in December 1961, held their second annual meeting on October 27, at the Patrick Henry Hotel at Roanoke, Virginia. This organization is composed of geologists residing within the state of Virginia in the fields of academic, commercial, governmental and private enterprise. Among other purposes of this organization, its main objective is to promote and establish reliable information for the public in order to protect them from the charlatan and the would-be-geologist. The officers of this organization are as follows: *President*, Mr. W. H. Vogelsang, Froehling & Robertson; *Vice-President*, Dr. A. C. Munyan, Tidewater College; *Secretary*, Dr. E. W. Spencer, Washington & Lee University; and *Treasurer*, Mr. E. L. Hockman, Sydnor Pump & Well Company, Inc. At the present time this organization consists of 43 charter members and the officers and the directors issue a cordial invitation to all geologists residing in Virginia to affiliate with the organization. The next meeting will be held in October, 1963.

Mr. J. P. Meador is now affiliated with Sydnor Pump and Well Company in Richmond, Virginia, as ground water geologist. Mr. Meador is a graduate of the University of Virginia and has been employed as a geolo-

**Representing
the
Most
Respected
Manufacturers
in the
Laboratory
Supply
Industry**

Corning Glass • Kimble Glass •
Coors Porcelain • Nalge Plastics
• Sheldon Furniture • Beckman
Instruments • Coleman Instru-
ments • American Optical Com-
pany • Bausch & Lomb, Inc. •
Eberbach Corporation • Inter-
national Equipment Company •
Burrell Corporation • Labora-
tory Equipment Company •
Ainsworth Balance • Ohaus
Balance • U.S. Stoneware •
J. T. Baker Chemicals • Mal-
linckrodt Chemicals • Matheson
Coleman & Bell Organics •
Precision Scientific Company •
Labline, Inc. • Thermolyne
Corporation • Buehler, Ltd. •
Baltimore Biological • Difco
Laboratories • Wm. Boekel &
Company • Humboldt Manufac-
turing Company • Hevi-Duty
Electric Company • W. A.
Taylor Company • Sartorius
Balance • Torsion Balance •
Hellige, Inc. • Plus Many
Others.

Serving the South for over 35 years

PHIPPS & BIRD, INC.



MANUFACTURERS AND DISTRIBUTORS OF SCIENTIFIC EQUIPMENT

6TH & BYRD STREETS — RICHMOND, VA.

PHONE MI 4-5401

gist by the Virginia Department of Highways, The Anaconda Copper Company, The Atomic Energy Commission, and The Aluminum Company of America.

Mr. W. T. Parrott of the Virginia Department of Highways attended the fourteenth annual Symposium on Geology as applied to highway engineering which was held at Texas A & M University. The main objective of this organization is to affect a closer liaison between the geologist and engineers by an interchange of information regarding the principals of geology and engineering as applied to these professions.

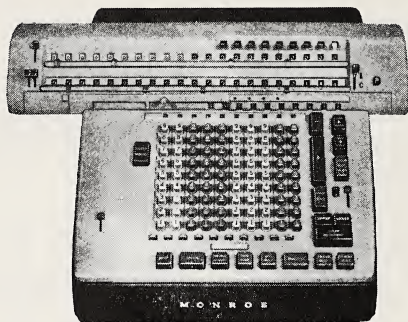
Victor Chew resigned from the Office of Chairman of Statistics Section of the Virginia Academy of Science. Mr. Chew left the state to accept employment with RCA at Cocoa Beach, Florida. Dr. Ronald E. Walpole, Head, Department of Mathematics at Roanoke College has been appointed Chairman of the Statistics Section to replace Mr. Chew.

Helen Bolt Chun completed her requirements for the master's degree in statistics and is teaching at the Women's Division of V.P.I. Daniel Sheehand completed his requirements for the master's degree in statistics and accepted a position in the Computing Center at V.P.I. He is continuing his graduate study toward a Ph.D. degree.

On November 17, 1962, the Statistics Section met with the Richmond and Waynesboro Sections of the American Society for Quality Control. This meeting was held at the West Inn in Waynesboro. Professor A. J. Metzger, Associate Professor of Ceramic Engineering, V.P.I., spoke on "Use of Statistics in Developing a Standard Test Method." Professor John G. Saw, Associate Professor of Statistics, V.P.I., then spoke on "Statistics in the Brewery". The attendees enjoyed a social gabfest and were served lunch. Following the lunch, Elbert Howard, Chief of Quality Assurance Branch, Directorate for Quality Control, Defense General Supply Center, Richmond, spoke on "Standardization and Value Engineering." The final speaker was Wallace L. Sandquist, U. S. Instrument Corporation, Charlottesville, on "Installing a Quality Control Program."

The Biology Department of Old Dominion College received a \$11,500 grant from the Atomic Energy Commission for equipment to be used in undergraduate courses to familiarize students with the principles of radiobiology. Dr. David E. Delzell, of Old Dominion College, is on the local committee for the establishment of a Zoological Society in the City of Norfolk. Dr. Daniel Sonenshine is working in cooperation with the Virginia State Department of Health on the Ecology of Rocky Mountain Spotted Fever.

Dr. W. S. Woolcott, of the University of Richmond, will teach a course in Ichthyology during the first term at the Mountain Lake Biological Station.



Schizophrenic!

The new IQ-213 won't believe it is merely a calculator. It is. But it refuses to act like one. Too limiting. It solves problems with greater speed and fewer operator decisions than any previous calculator ever has, reducing most computational activity to mere push-button procedures. It stores ten digit constants in its memory for recall whenever you want them. It enables you to multiply a large constant by a smaller variable. It even recalls constant divisors from memory—something no calculator has ever before been able to do—thereby eliminating the need for reciprocals in most problems. All at the touch of a single button! Additionally, it automatically programs itself for every calculation, removing the need for any manual positioning, clearing, or setting when changing from one arithmetic sequence to

another . . . and eliminates the physical handling of intermediate figures usually necessary on ordinary calculators. (In a three-factor problem, each figure can be loaded into the machine before the first multiplication takes place. Press the button and the problem unravels itself!) What's more, it automatically accumulates multipliers (as a by-product of squaring in standard deviation) and quotients (in correlation work). No wonder it rebels at being categorized with machines so much more limited! Actually, it is simply the most automatic and most accurate calculator ever produced, well worth its price of one thousand eighty-five dollars. See for yourself. Call your local Monroe representative (he's listed in the phone book) for a demonstration today.

MONROE 
GENERAL OFFICES: ORANGE, NEW JERSEY • A DIVISION OF LITTON INDUSTRIES

Professors James Norman Dent and W. Ralph Singleton, of the University of Virginia, will leave during the latter part of January for a three-month visit to Manila in the Philippines. They will assist in the setting up of a program for the peaceful use of atomic energy in the Philippines under the auspices of the University of Virginia and the U. S. Department Agency for International Development.

For the summer of 1963, the Virginia Institute of Marine Science has grants from the National Science Foundation to operate three programs. They are as follows: *Research Participation for College Teachers*. Stipends of \$75 are available for two predoctoral participants and \$100 per week for each of five postdoctoral participants. The program will begin June 10 and close the end of August. *Undergraduate Science Education Program*. Stipends of approximately \$60 per week will be paid ten undergraduates to pursue individual research under the direction of scientists at the Institute beginning June 10 and operating for ten weeks. *Cooperative College-School Science Program*. This program is operated in conjunction with the Norfolk City Schools and will be held at Norview High School at Norfolk, Virginia. Only teachers and students living within commuting distance are eligible to apply.

Dr. B. Joseph, Head of the Department of Ichthyology at the Virginia Institute of Marine Science, is conducting studies of culture techniques for laboratory rearing of marine fishes through funds supplied from a National Science Foundation grant. Dr. J. Hargis, Jr., Director of the Institute of Marine Science, is engaged in the studies of host specificity and zoogeography of monogenetic trematodes. His work on parasites of Antarctic vertebrates and invertebrates is supported by a National Science Foundation grant. Dr. C. Patten has received a \$17,893 ONR grant for the study of community organization and energy relationship in plankton.

The National Science Foundation recently awarded a grant of \$15,000 to Lynchburg College for work to be done by Dr. Paul J. Osborne over a period of two years in the new biology facilities at Lynchburg. This is to entail histochemical analysis of lower phylogeny and ontogeny of some vertebrates for roles of phosphatases in early stages of differentiation, as well as to determine persistent roles of the enzymes.

Dr. Robert K. Burns, Interim Professor of Biology at Bridgewater College, will continue his research on the effects of hormones in sex differentiation in the opossum, during a stay of about two months at the University of Florida's Wildlife Reserve at Welaka. He is to return to the Bridgewater campus in early April.

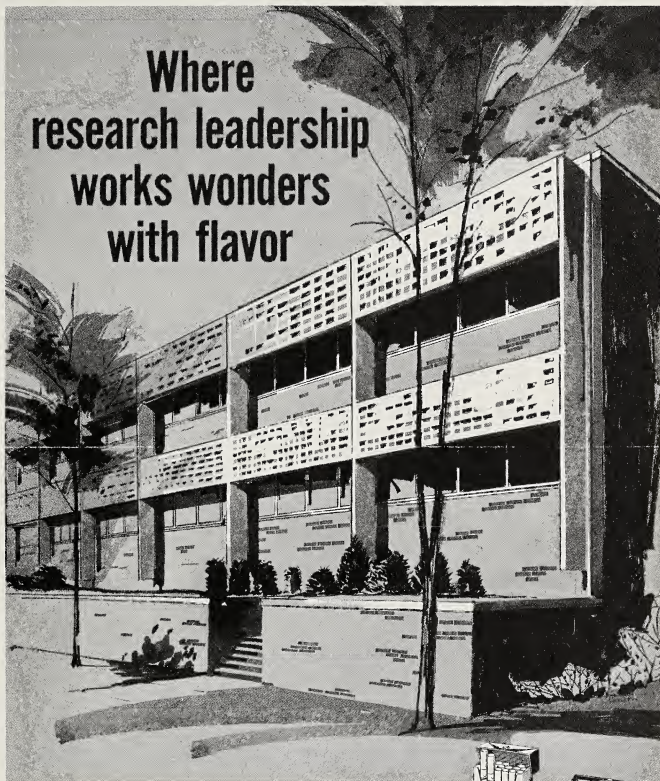
Dr. Jesse C. Thompson, Jr., Hollins College, has accepted a professorship of Biology at Hampden-Sydney College, and will occupy this position in September of 1963.

The Virginia Branch of the American Society of Microbiology held its fall meeting at the University of Virginia. After the business meeting there was a symposium on, *The Teaching of Microbiology* with J. D. Reid of MCV as moderator. Participants and their subject areas were W. A. Dorsey, Public Health Laboratory, Richmond, *High School Biology Programs*; N. Krieg, V.P.I., *College and University Setting*; Q. Myrvik, University of Virginia, *Medical School Setting*; and G. Moskovits, Virginia Institute of Marine Science, *Research Institute Setting*.

M. B. Rowe for many years Supervisor of the Fertilizer and Motor Fuel Section in the State Department of Agriculture, has assumed the position of Executive Assistant to Commissioner R. D. Chumney. E. H. Isbell, formerly Field Inspection Supervisor, has been appointed Acting Supervisor of the Fertilizer and Motor Fuel Section to succeed Mr. Rowe.

B. W. Southall, Supervisor of the Feed and Animal Remedy Section of the State Department of Agriculture, has resigned to accept a position with the U. S. Food and Drug Administration. Mr. C. Spruill, former Field Inspection Supervisor, has been appointed Acting Supervisor of the Feed and Animal Remedy Section to succeed Mr. Southall.

Where
research leadership
works wonders
with flavor



The Philip Morris Research Center near Richmond, Va., where scientists are now working with the finest facilities ever assembled for tobacco research.

PHILIP MORRIS
INCORPORATED

Makers of the world's finest cigarettes



BUSINESS MEMBERS
VIRGINIA ACADEMY OF SCIENCE

Albemarle Paper Manufacturing Company
Allied Chemical Corporation
The American Tobacco Company
Dan River Mills
The Dow Chemical Company
E. I. du Pont de Nemours and Company, Inc.
First and Merchants National Bank
General Electric Company
Larus and Brother Company, Inc.
The Newport News Shipbuilding Company Foundation
Norfolk and Western Railway Company
Philip Morris and Company, Limited, Inc.
Phipps and Bird, Inc.
Reynolds Metals Company
A. H. Robins Company
Southern Materials Company
State-Planters Bank of Commerce and Trusts
Virginia-Carolina Chemical Corporation
Virginia Chemicals and Smelting Company

Virginia Academy of Science

Program

OF THE

Forty-First Annual Meeting

ROANOKE, VIRGINIA



May 1-4, 1963

Virginia Academy of Science

OFFICERS

Jackson J. Taylor, *President*

Foley F. Smith, *President-Elect*

Paul M. Patterson, *Secretary*

Rodney C. Berry, Sr., *Treasurer*

William B. Wartman, *Assistant Secretary-Treasurer*

LOCAL COMMITTEE ON ARRANGEMENTS

General Chairman: Boyd Harshbarger, Virginia Polytechnic Institute

Registration: H. L. Holloway, R. W. Wine and R. W. Engel

Housing: Beatrice E. Gushee

Junior Academy: C. E. Trent

Commercial Exhibits: N. F. Murphy

Meeting Rooms and Equipment: S. S. Obenshain and J. B. Eades, Jr.

Public Information: Gene S. Moody

Tours: P. R. Thomson and A. T. Crowley

Entertainment for Ladies: Dorothy D. Montgomery and Ruth Painter

General Program Of The 41st Annual Meeting

HOTEL ROANOKE

Press Room—Parlor L

WEDNESDAY, MAY 1

- 1:00 p.m. Registration, Junior Academy of Science (VJAS), Oval Room.
Set up club exhibits.
- 7:00 p.m. VJAS Committee Meeting, Parlor D.
- 8:00 p.m. VJAS Guest Speaker, Shenandoah Room.

THURSDAY, MAY 2

- 8:00 a.m. Registration, Lobby. Exhibits, Ballroom.
- 9:00 a.m. Virginia Science Talent Interviews, Parlor G, K, Rooms 218, 317, 418.
- 9:00 a.m. Concurrent Sessions of VJAS.
- 1:30 p.m. Concurrent Sessions of VJAS.
- 2:00 p.m. Meeting of the Council, Parlor D.
- 2:00 p.m. Section of Science Teachers, Virginia Room.
- 4:30 p.m. VJAS, Meeting of Judges, Parlor F.
- 8:00 p.m. Annual Academy Conference, Cavalier & Pocahontas Rooms.
- 8:00 p.m. Lecture for VJAS, Shenandoah Room.

FRIDAY, MAY 3

- 8:00 a.m. Registration, Lobby. Exhibits, Ballroom.
- 8:00 a.m. *SECTION MEETINGS*—See detailed section of the program.
- 10:00 a.m. Awards hour for VJAS.
- 1:00 p.m. *SECTION MEETINGS*—See detailed section of the program.
- 8:00 p.m. Virginia Academy of Science Assembly. Short business meeting. Election of officers. Presentation of awards. Guest Speaker, Dr. John A. Sauer, Department of Physics,

Pennsylvania State University, *Molecular Motion in Solids*.
Shenandoah Room.

SATURDAY, MAY 4

- 8:00 a.m. *SECTION MEETINGS*—See detailed section of the program.
10:00 a.m. Meeting of the Council, Parlor D.

Section Of Agricultural Science

FRIDAY, MAY 3,—8:20 A.M.

PARLOR F

1. 8:30 Colorado Potato Beetle Resistance to Insecticides on the Eastern Shore of Virginia. R. N. Hofmaster, Virginia Truck Experiment Station, Painter.
2. 8:45 Peanut Rust in Virginia. Grover C. Smart, Jr., Virginia Agricultural Experiment Station, Holland.
3. 8:55 The Use of Plant Resistance in Controlling Insect Pests of Peanuts in Virginia. M. W. Alexander and G. M. Boush, Virginia Agricultural Experiment Station, Holland.
4. 9:10 New Concepts in the Employment of Soil Insecticides. G. M. Boush and M. W. Alexander, Virginia Agricultural Experiment Station, Holland.
5. 9:25 Further Selection of Normal and Chlordane-Resistant German Cockroaches for Resistance to Malathion and Diazinon. James McD. Grayson, Virginia Agricultural Experiment Station.
6. 9:35 Cross Resistance to Insecticides in the German Cockroach. Donald G. Cochran, Virginia Agricultural Experiment Station.
- 9:47 Intermission
7. 10:02 Pathogenicity, Morphology and Life Cycle of Certain Isolates of *Ditylenchus destructor*. Grover C. Smart, Jr., Virginia Agricultural Experiment Station.
8. 10:17 Buckwheat, *Fagopyrum esculentum*, a New Host of the Knotweed Cyst Nematode, *Heterodera weissi*. Paul L. Duke and Lawrence I. Miller, Virginia Agricultural Experiment Station, Holland.
9. 10:27 A Comparison of the Gross Morphology of Three Populations of the Sting Nematode in Virginia. Betty J. Gray and Lawrence I. Miller. Virginia Agricultural Experiment Station, Holland.
10. 10:37 Survival of *Eimeria acervulina* Oocysts under Laboratory Conditions. Marion M. Farr and Davis Doran, Beltsville Parasitological Laboratory, Agricultural Research Service, Beltsville, Maryland.

11. 10:49 The Eradication of the Swine Kidney Worm, *Stephanurus dentatus* by Herd Management. T. B. Stewart, O. M. Hale, B. L. Southwell, John S. Andrews, W. N. Smith, and D. J. Jones, Beltsville Parasitological Laboratory, Agricultural Research Service, Beltsville, Maryland.
12. 11:04 *Vibrio fetus* Endotoxin. J. Clark Osborne and R. M. Smibert. Virginia Agricultural Experiment Station.
13. 11:16 Studies on the Mechanism of Arsanilic Acid Toxicity in the Chick. Everett L. Wisman, Virginia Agricultural Experiment Station.
14. 11:31 Composition of Swine Colostrum and Milk: Major Constituents and Zinc. Vernon Scarborough and I. P. Earle. Animal Husbandry Research Division, Agricultural Research Service, Beltsville, Maryland.
15. 11:46 Adjustable Equipment for Separate Collection of Excreta from Barrows. David P. Morgan and R. J. Davey. Animal Husbandry Research Division, Agricultural Research Service, Beltsville, Maryland.
- 12:05 Adjourn for Lunch
16. 1:15 Soil Moisture as Influenced by Cropping and Irrigation. E. M. Dunton, Jr., Virginia Truck Experiment Station, Painter.
17. 1:30 The Hydrolysis of Iron in Cation Exchangers. Grant W. Thomas, Virginia Agricultural Experiment Station.
18. 1:45 The Effect of Gypsum, Lime and Fertilizer on Soybeans Grown on Three Soil Types in Southeastern Virginia. D. L. Hallock, Virginia Agricultural Experiment Station, Holland.
19. 1:55 Comparative Response of Alfalfa to Topdressed Superphosphate and Phosphate Rock. W. W. Moschler and G. D. Jones, Virginia Agricultural Experiment Station.
20. 2:10 The Use of C_6H_5OH in Trueness-to-Variety Tests. T. Graham Copeland, Jr., W. E. Walls and F. A. Agnew, Virginia Department of Agriculture.
21. 2:25 Drying Rate and Quality of Hay Cut with Self-Propelled Windrower-Conditioners. Tin M. Nyunt and Floyd M. Cunningham. Virginia Agricultural Experiment Station.
- 2:35 Intermission
22. 2:50 Influence of Ultra-Violet, Sonic and Electromagnetic Energy on

Spinach Seed. Thomas M. Roane and U. F. Earp, Virginia Agricultural Experiment Station.

23. 3:05 Extraction of Reduced Cytochromes 552 and 556 from *Euglena*. Germille Colmano, Virginia Agricultural Experiment Station.
24. 3:20 Factors Affecting Consumption of Processed Potato Products for Food. Olman Hee, Economic and Statistical Analysis. Division, Economic Research Service, Washington, D. C.
25. 3:35 Distribution of Pith-Fleets in Wild Black Cherry. Herbert M. Kulman, Virginia Agricultural Experiment Station.
26. 3:45 A Discussion of Doctrines Governing the Use of Water in the Continental United States with Special Reference to Virginia. Carl J. Holcomb, Virginia Agricultural Experiment Station.

4:00 Business Meeting.

SATURDAY, MAY 4—8:30 A.M.

PARLOR F

27. 8:30 Variation Among Homozygous Dwarf, Heterozygotes and Homozygous Normal Beef Cattle. Thomas J. Marlowe, Virginia Agricultural Experiment Station.
28. 8:45 Genetic Variation in Chick Bioassays for Gonadotropins. I. Testes Weight and Response. P. B. Siegel and H. S. Siegel, Virginia Agricultural Experiment Station.
29. 9:00 Genetic Variation in Chick Bioassays for Gonadotropins. II. Histological and Histochemical Responses. H. S. Siegel and P. B. Siegel, Virginia Agricultural Experiment Station.
30. 9:15 Genetic and Environmental Factors Affecting Twinning in Sheep. Edward A. Mechling, II and Robert C. Carter. Virginia Agricultural Experiment Station.

9:30 Intermission

31. 9:45 Sebaceous Glands of Sheep and Goats. Lubow A. Margolena, Animal Husbandry Research Division, Agricultural Research Service, Beltsville, Maryland.
32. 10:00 Hierarchical Structure in the Pedigree Breeds of Livestock. Kitty Phillips Smith and Robert C. Carter. Virginia Agricultural Experiment Station.
33. 10:15 Behavior Patterns in Game Birds from 6 to 13 Weeks of Age.

F. C. Wiley, III and P. B. Siegel, Roanoke College and Virginia Agricultural Experiment Station.

34. 10:30 Exercises and Instruction in Soil Science for High School Science Departments. John D. Pendleton, Virginia Agricultural Experiment Station.

Section Of Astronomy, Mathematics And Physics

FRIDAY, MAY 3—9:00 A.M.

PARLOR D

1. 9:00 Microwave Cavity Measurements of the Faraday Effect in a Magnetized Gaseous Plasma. Maurice T. Raiford, College of William and Mary.
2. 9:15 "A Rotor Clock". J. W. Beams, University of Virginia.
3. 9:30 Plasma Oscillations and Conduction Phenomena in a Penning Ionization Gauge. Frederic R. Crownfield, College of William and Mary.
4. 9:45 A Method of Establishing Desired Temperature Distributions in a Multiple-Winding Tubular Furnace. J. C. Martin, Jr. and E. F. Turner, Jr., Washington and Lee University.
5. 10:00 On Magnetic Field Homogeneity with Air Core Coils. Frederic R. Crownfield, Jr., College of William and Mary.
6. 10:15 Determination of Partial Specific Volumes. Dale V. Ulrich, University of Virginia.

10:30 COFFEE BREAK

7. 10:45 A Versatile, Inexpensive 35mm Photographic System for Photomicrography, Copying, and Lantern Slide Production. R. T. Spencer and J. T. Ratchford.
8. 11:00 The Microphotometer. Robert M. Elton and Robert D. Rose, University of Virginia.
9. 11:15 Telemetering from Rotors. Thomas K. Robinson, University of Virginia.
10. 11:30 Determination of Molecular Weights of Viruses. Faustin N. Weber, Jr., University of Virginia.

11. 11:45 Determination of Molecular Weight Distribution of Polymers. Hyo-Gun Kim, University of Virginia.
12. 12:00 Conductometric Measurement of Electron Production in Water by X-rays. William E. Keefe and R. C. Williams, Medical College of Virginia.

LUNCH BREAK

1:30 Business Meeting

13. 1:45 Probability of Radiative Collisions of Electrons in Different Target Materials. Maurice C. McGee, Louis A. Galloway, and J. J. Singh, College of William and Mary.
14. 2:00 Survey of (d,n) Reactions. L. van der Zwan, University of Virginia.
15. 2:15 Recoil Particles from Deuteron Reactions. Charles D. Porterfield, University of Virginia.
16. 2:30 Angular Distribution of Photoprotons from Carbon. Holland D. Warren, University of Virginia.
17. 2:45 Photoneutron Cross Sections for Light Elements. Lee N. Bolen and K. Min, University of Virginia.

3:00 BREAK

18. 3:15 Multidetector Arrays for Charged Particles. Andrew P. Borden, University of Virginia.
19. 3:30 A Measurement of the MEV Region Neutron Spectrum from the UTR-10 Reactor. A. K. Furr and R. S. Runyon, Virginia Polytechnic Institute.
20. 3:45 A Study of Paraffin Shapes with Pulsed Neutrons. Y. P. Hwu, H. D. Curet and A. Robeson, Virginia Polytechnic Institute.
21. 4:00 Performance of a Plasma Thermocouple with a Graphite Cathode. W. W. Scott and J. L. Meem, University of Virginia.
22. 4:15 Measurement of Subcritical Multiplication. T. W. T. Burnett and T. G. Williamson, University of Virginia.
23. 4:30 An Attempt at a "Mathematization" of Certain Truth Functions. Herta Taussig Freitag, Hollins College, and Arthur H. Freitag, Wm. Fleming Senior High School.

SATURDAY, MAY 4—9:00 A.M.

POCAHONTAS ROOM

24. 9:00 The Growth and Etching of Crystals of Zinc and Cadmium. K. G. Everett, R. A. Paddock, and J. T. Ratchford, Washington and Lee University.
25. 9:15 Changes of Optical Properties of Fresh, Metallic Thin Films due to Exposure to Gases. H. H. Hsu, J. W. Shermen, and H. Y. Loh, Virginia Polytechnic Institute.
26. 9:30 A Study of the Nuclear Quadrupole Resonance Spectrum of Beryllium and Chrysoberyl. Harry L. Reaves and T. E. Gilmer, Jr., Virginia Polytechnic Institute.
27. 9:45 Infrared Absorption Spectrum of Lithium-Doped Silicon. Robert J. Bell and T. E. Gilmer, Jr., Virginia Polytechnic Institute.
28. 10:00 Experiments on the Equilibration of Copper Surfaces. J. W. Mitchell, University of Virginia.
29. 10:15 Axial Dislocation in Thin Ribbons of Aluminum Nitride. Charles Drum, University of Virginia.
30. 10:30 Electron Microscope Studies of Fracture in Thin Ribbons of Cadmium. John C. Crump, III, University of Virginia.
31. 10:45 Tensile Strength of Iron Whiskers. William L. Piotrowski and J. W. Beams, University of Virginia.
32. 11:00 Magnetoresistance in Zinc. Acar Isin and R. V. Coleman, University of Virginia.
33. 11:15 Magnetoresistance in Copper. A. J. Funes and R. V. Coleman, University of Virginia.

Section Of Biology

FRIDAY, MAY 3, — 8:00 A.M.

CAVALIER ROOM

8:00 Announcements. Introductory Remarks.

1. 8:10 Forest Cutting and Its Influence on Browse Production. David R. Patton, Va. Cooperative Wildlife Res. Unit, Virginia Polytechnic Institute.

2. 8:20 A Self-operated Camera for Recording Wild Turkey Abundance and Distribution. Joseph P. Bachant, Virginia Polytechnic Institute.
3. 8:35 A Revision of the Neotropical Genus *Erilophodes* (Lepidoptera; Geometridae). Charles V. Covell, Jr., Virginia Polytechnic Institute.
4. 8:50 *Botrychium alabamence*, Maxon and *B. matricariifolium*, A.Br. in Virginia. A. B. Massey, Virginia Polytechnic Institute Herbarium.
5. 9:00 Plants of the Massanutten Mountains in Virginia that are not Abundant in that Area. Lena Artz, Waterlick, Virginia.
6. 9:15 Some Observations on Tissue and Cell Metabolism of Small Rodent Populations. June C. Hill and Ruth C. Mayhew, Madison College.
7. 9:30 Beta-alanine Utilization in Ebony and Non-ebony *Drosophila melanogaster*. M. E. Jacobs and K. K. Brubaker, Eastern Mennonite College.
8. 9:40 Notes on Oklahoma Planarians. Marie M. Jenkins, Madison College.
9. 9:55 On the Ozark Crawfishes Collected by Perry C. Holt. J. F. Fitzpatrick, Jr., University of Virginia.
10. 10:10 Preliminary Observations on Gonadectomy in Crawfishes. J. F. Fitzpatrick, Jr. and James N. Dent, University of Virginia.
11. 10:25 Population Ecology of the Tree Frog, *Cochranella fleischmanni*. Duvall A. Jones, Ferrum Junior College.
12. 10:40 Reproduction in East North American *Ruellia* L. (Acanthaceae): Observations and Taxonomic Implications. Leonard J. Uttal, Madison Heights, Virginia.
13. 10:55 The Distribution, Hosts, and Seasonal Occurrence of Virginia Ticks. Daniel E. Sonenshine, Old Dominion College, and John E. Lamb, Virginia State Department of Health, Norfolk.
14. 11:10 The Ecology of Rocky Mountain Spotted Fever in Virginia. John E. Lamb and Paul P. Woronecki, Virginia State Department of Health, Norfolk, and Daniel E. Sonenshine, Old Dominion College.
15. 11:25 The Effect of Different Photoperiods on the Expression of the

Non-Stoloniferous Character in Seedling Strawberries. Edward G. Corbett, Old Dominion College.

16. 11:40 An Analysis of the Virginia Avifauna. J. J. Murray, The Virginia Society of Ornithology, Lexington.
17. 11:50 An Inexpensive Remote-indicating Temperature Measuring Device. Addison D. Campbell and Jack D. Burke, University of Richmond.

12:00 Luncheon Recess.

18. 1:30 Vegetation and Small Mammal Populations of Natural and Disturbed Piedmont Forests. Dorothy L. Crandall and J. L. Chamberlain, Randolph-Macon Woman's College.
19. 1:40 Mechanism of Gene Controlled Resistance vs. Sensitivity to Calcium in *Podospira anserina* Niessl. James E. Perham, Randolph-Macon Woman's College, and A. Gib DeBusk, Florida State University.
20. 1:50 A New Subgenus in *Luzula* (Juncaceae). John E. Ebinger, Roanoke College.
21. 2:05 The Helminths of Opossums in Western Virginia. Harry L. Holloway, Jr. and Janet L. Dowler, Roanoke College.
22. 2:15 The Effect of *Lophopodella carteri* Extract on Various Fishes. Wilton R. Tenney and William S. Woolcott, University of Richmond.
23. 2:30 The Pure Culture of *Saprolegnia* spp. on a Chemically Defined Medium. W. W. Scott, J. R. Powell, and R. L. Seymour, Virginia Polytechnic Institute.
24. 2:45 The Influence of Light on the Growth and Reproduction of *Saprolegnia parasitica* Coker. Philip C. Lee, Virginia Polytechnic Institute.

3:00 Section Business Meeting.

25. 3:30 The High School Challenge in Biology. Vera B. Remsburg, Herndon High School, Fairfax County.
26. 3:45 Observations on the Genus *Isoachlya*. Roland L. Seymour and W. W. Scott, Virginia Polytechnic Institute.
27. 4:00 Laboratory Studies on the Control of Fungus Infections of Fishes. Charles O. Warren, Jr. and W. W. Scott, Virginia Polytechnic Institute.

28. 4:15 Mineral Requirements of Selected Species of Aquatic Hyphomycetes. Don W. Hickman and W. W. Scott, Virginia Polytechnic Institute.
29. 4:30 Studies on the Fungus Flora of Marine and Brackish Waters in the Vicinity of Gloucester Point, Virginia. W. W. Scott, Virginia Polytechnic Institute.
30. 4:45 The Origin and Characteristics of Strain EU 6010, *Tetrahymena pyriformis*. Carolyn Wells, Longwood College.

SATURDAY, MAY 4—8:00 A.M.

CAVALIER ROOM

8:00 Announcements.

31. 8:05 A Laboratory Device For Accelerating Photosynthesis in Elodea. James F. Ferry, Madison College.
32. 8:15 The Genetics of Mottling and Microphthalmia in the Syrian Hamster. Michael B. Berman and Roscoe D. Hughes, Medical College of Virginia.
33. 8:30 Development of Alpha-amylase in Marine Embryos. Robert E. Black, College of William and Mary.
34. 8:45 Seasonal Incidence of Intestinal Parasites in the Ground Skunk, *Lygosoma laterale* (Say). G. R. Brooks, Jr., College of William and Mary.
35. 9:00 Aspects of Radiosensitivity Based on Work with *Pinus*. Robert Peidigo, College of William and Mary.
36. 9:15 The Effects of Aggregation and of Social Rank upon the Catechol Amine Content of the Adrenal Medulla of Mice. Bruce L. Welch, College of William and Mary.
37. 9:30 From Coral Reef to Tropical Island via *Thalassia* and Mangrove. Bruce L. Welch, College of William and Mary.
38. 1:45 The Nucleolus of *Lilium*. Franklin F. Flint, Randolph Macon Woman's College.
39. 10:00 Ecological Changes in an Old "Chestnut-Oak" Forest. Alice V. Racer and W. S. Hooks, Randolph-Macon Woman's College.
40. 10:15 Ecotypes in *Goodyera pubescens* Willd. W. S. Hooks, Randolph Macon Woman's College.
41. 10:30 The Effects of Ultraviolet Radiation on the Viability of Trans-

planted Bone Marrow Cells. Nancy Tates Sparks, Randolph-Macon Woman's College.

42. 10:45 Differential Growth Effects of Living and Dead Micro-organisms on Various Species of Anoetids (Acarina). Justine M. Murphy and R. D. Hughes, Medical College of Virginia.
43. 11:00 X-irradiation Effects on Parthenogenetic Species of Anoetids (Acarina). Caroline Goode Jackson and R. D. Hughes, Medical College of Virginia.
44. 11:15 Incipient Subspecies Within *Drosophila tropicalis* and *Drosophila equinoxialis*. J. Ives Townsend, Medical College of Virginia.
45. 11:30 The Genus *Buxus*, and Recent Efforts to Broaden our Knowledge of it. Walter S. Flory, Jr., The Blandy Experimental Farm, University of Virginia.
46. 11:35 The Chromosomes of T/21 Mongolism, T/21 Mongolism (Mosaic and T/ s6, or T/L16. Ladley Husted, University of Virginia and Lyman R. Emmons, Washington and Lee University.
47. 11:45 Protein Uptake by Planarians. Paul Osborne, Lynchburg College.
48. 11:55 The Acute Toxicity of Molybdenum to the Bluegill. Richard L. Easterday and Russell F. Miller, Virginia Polytechnic Institute.

Section Of Chemistry

FRIDAY, MAY 3 — 8:40 A.M.

POCAHONTAS ROOM

8:40 Announcements, Introductory Remarks

1. 8:45 The Development of a Research Oriented Undergraduate Chemistry Curriculum. G. Tyler Miller, Jr., Chemistry Department, Hampden-Sydney College.
2. 9:00 An Electron Microscopic Study of the Oxidation of Copper Crystals in Aqueous Solutions of Cupric Acetate. C. E. Gathrow, Jr., and G. T. Miller, Jr., Chemistry Department, Hampden-Sydney College.

3. 9:10 Semiquantitative Charge-Cloud Pictures of Orbitals and Bonds. Frederick M. Hornyak, Chemistry Department, Virginia Polytechnic Institute.
4. 9:20 The Activity of AgNO_3 in the Molten Salt System $\text{KNO}_3\text{-AgNO}_3\text{-K}_2\text{CuO}_4$ at High Temperatures. Robert M. Auburn and William J. Watt, Chemistry Department, Washington and Lee University.
5. 9:35 The Enthalpies and Entropies of Reactions of Some Silver and Ethylenediamine Complexes. Richard A. Jesser, Jr. and Robert L. Graham, Chemistry Department, Virginia Polytechnic Institute.
6. 9:50 The Hydrothermal Treatment of Afwillite, $\text{Ca}_3(\text{SiO}_3\text{OH})_2 \cdot 2\text{H}_2\text{O}$. H. F. W. Taylor and A. W. Nichol, University of Aberdeen, Scotland and Materials Research Laboratory, Pennsylvania State University.
7. 10:05 Microstructural Observations of Boron Filaments. Franklin E. E. Wawner, Jr., Texaco Experiment Incorporated, Richmond.
8. 10:20 The Infrared Absorption Spectrum of Liquid BF_3 . Elizabeth Anne Dodd, Martha Welch Jordan, and Ralph G. Steinhardt, Jr., Chemistry Department, Hollins College.
9. 10:30 A New Spectrophotometric Method for the Determination of Microgram Amounts of Selenium. G. F. Kirkbright and John H. Yoe, Pratt Trace Analysis Laboratory, Chemistry Department, University of Virginia.
10. 10:40 Spectrophotometric Studies with Certain Diazo Dyes and Their Reactivity with Metallic Ions; Determination of Gallium with 1-(2,4-dihydroxyphenylazo)-2-naphthol-4-sulfonic acid. Teh Liang Chang and John H. Yoe, Pratt Trace Analysis Laboratory, Chemistry Department, University of Virginia.
11. 10:50 A New Spectrophotometric Method for Manganese. Leory Pike and John H. Yoe, Pratt Trace Analysis Laboratory, Chemistry Department, University of Virginia.
12. 11:00 Possible Application of Positron Annihilation to Analytical Chemistry. Robert C. McIlhenny, Melpar, Inc., Falls Church.
13. 11:15 The Quantitative Measurement of Urinary Pregnenediol by Gas-Liquid Chromatography. Mary Ann Hurley and Edward A. Garlock, Hazelton Laboratories, Inc., Falls Church.
14. 11:30 A Reciprocating, High Rate of Shear, Capillary Viscosimeter.

V. M. Barnes, Jr., N. E. Flournoy, and E. H. Rowe, Texaco Experiment Incorporated, Richmond.

11:40 BUSINESS MEETING

12:00 LUNCH RECESS

15. 1:00 Some Reactions of 2,5-Dihydrothiophene 1-Oxide. Robert C. Krug and Donald E. Boswell, Chemistry Department, Virginia Polytechnic Institute.
16. 1:10 Condensation Reactions of Hydroxylated Organic Compounds with 1,2-Ethanedithiol. Ann S. Delk and Nancy Harris, Chemistry Department, Mary Baldwin College.
17. 1:20 A Novel Phenyl Group Migration. Robert E. Lutz, John I. Dale, and David W. Boykin, Jr., Chemistry Department, University of Virginia.
18. 1:35 Infrared Structure Spectra Correlation in Substituted Olefins. W. L. Truett, "Orlon" Technical Division, Benger Laboratory, E. I. duPont de Nemours & Co., Waynesboro.
19. 1:50 Thin Layer Chromatography of Aromatic Nitro and Amino Compounds. Mary D. Christian, Sam Rose, and H. deSchmerzizing, Melpar, Inc., Falls Church.
20. 2:05 Combination of Steric and Polar Effects in Schiff Base Formation. Thomas I. Crowell, Chemistry Department, University of Virginia, and Charles E. Bell, Jr., Old Dominion College.
21. 2:20 Reactions of Phosphorus Esters with Amines. W. M. Byrd and R. T. Kemp, Research Department, Virginia-Carolina Chemical Corporation, Richmond.
22. 2:35 Synthesis and Properties of Some 3,5-Disubstituted Urons. Allan A. Eisenbraun, C. R. Walter and D. S. Shriver, Nitrogen Division Development Department, Allied Chemical Corporation, Hopewell.
23. 2:45 4-(β -Substituted-ethyl)-3,3-diphenyl-2-pyrrolidinones. A New Series of CNS Stimulants, Part II. Albert D. Cale, Jr., Carl D. Lunsford, and Herndon Jenkins, Research Laboratories, A. H. Robbins Co., Richmond.
24. 2:55 Condensed Carbocyclic Derivatives of Pyrrolidines. Norman D. Dawson, Carl D. Lunsford, Edward K. Rose, and Albert D. Cale, Jr., Research Laboratories, A. H. Robbins Co., Richmond.
25. 3:05 The Determination, Distribution and Metabolism of Doxapram

Hydrochloride (AHR-619). Robert B. Bruce and Franklin M. Pinchbeck, Research Laboratories, A. H. Robins Co., Richmond.

26. 3:15 Studies in the 3,6-Pyridazindione Series. Lowell Heisey, Lawrence Baxter, Allen Rhodes, and Stuart Suter, Chemistry Department, Bridgewater College.
27. 3:25 Investigations of an Interesting Rearrangement of Dipyriddy Sulfides. O. R. Rodig, R. K. Schlatzer, Jr., and R. E. Collier, Chemistry Department, University of Virginia.
28. 3:40 The Thermodynamics of the Partition of 8-Hydroxyquinoline Between Several Organic Solvents and Water. Irving Lipschitz and John G. Mason, Chemistry Department, Virginia Polytechnic Institute.
29. 3:55 Photochemical Reactions of Metal Carbonyls with 1,3-Diketones and 8-Hydroxyquinoline. J. C. Goan, T. Iapalucci, E. Berg, and H. E. Podall, Melpar, Inc., Falls Church.
30. 4:10 The Synthesis and Reactions of Some New Complex Ketones Containing *ortho* Halogen. F. A. Vingiello, L. Ojakaar and J. Yanez, Chemistry Department, Virginia Polytechnic Institute.
31. 4:20 The Synthesis of Gamma-Semicarbazidobutyric Acid. James K. Shillington, G. Ashley Allen, and Hugh Trout, III, Chemistry Department, Washington and Lee University.
32. 4:30 The Synthesis of 4-Carboxybenzenesulfhydrazide and Its Use as a Carbonyl Reagent. James K. Shillington, Edward B. Eadie, Jr., Thomas W. Fauntleroy, Jr., and F. Scott Kennedy, Jr., Chemistry Department, Washington and Lee University.
33. 4:40 Further Studies on the Conversion of Nicotine to Nor nicotine in Tobacco. W. Stepka and L. J. Dewey, Research Laboratories, American Tobacco Co., Richmond.
35. 4:55 Resistance at a Distance—Stereochemistry of Free-Radical Addition of Thiolacetic Acid to 4-*tert*-Butylcyclohexene. George S. Whitney, Chemistry Department, Washington and Lee University.

Section Of Engineering

FRIDAY, MAY 3—9:00 A.M.

VIRGINIA ROOM

1. 9:00 Carbon Migration Between Ferritic and Austenitic Steels in the Presence of a Barrier. Michael Evan, Metallurgical Engineering Department, Virginia Polytechnic Institute.
2. 9:30 Development of an Ignition Criterion for Turbulent, High Velocity, Pilot Stabilized Flames at Low Pressures. Richard G. Griskey, Chemical Engineering Department, Virginia Polytechnic Institute.
3. 10:00 Research on Nails and Nailing Procedures. E. George Stern, Wood Construction Department, Virginia Polytechnic Institute.
4. 10:30 Recent Trends in the Patent System. Auzville Jackson, Jr., Robertshaw Controls Company.
5. 11:00 A_3B Structures in the V-Rh-Si System. R. V. Lawrence, Metallurgical Engineering Department, Virginia Polytechnic Institute.
6. 11:30 Hydraulic Disruption and Re-entrainment of Froth. D. F. Alt, W. A. Parsons and H. R. Bungay, III, Civil Engineering Department, Virginia Polytechnic Institute.
7. 1:00 Strength of Compacted Mica-Quartz Sand Mixtures. H. S. Bhat and R. D. Krebs, Civil Engineering Department, Virginia Polytechnic Institute.
8. 1:30 Secondary Compression and Soil Character. D. W. Smith and R. D. Krebs, Civil Engineering Department, Virginia Polytechnic Institute.
9. 2:00 Portland Cement Concrete Stress Resulting from Plastic Shrinkage. Howard Newlon, Jr., Research Engineer, Virginia Council of Highway Investigation and Research.
10. 2:30 Electrodeposition of Alloys of Molybdenum and Chromium. H. L. McCutchen and Nelson F. Murphy, Chemical Engineering Department Virginia Polytechnic Institute.
11. 3:00 Lateral Range and Hypersonic Lift-Drag Ratio Requirements for Efficient Ferry Service for A Near-Earth Manned Space

Station. Donald L. Baradell and Charles H. McLellan, Langley Research Center, National Aeronautics and Space Agency.

12. 3:30 Effect of Orbital Altitude on Retro-Thrust and Re-Entry Requirement for Return from a Manned Space Station. E. Brian Pritchard, Langley Research Center, National Aeronautics and Space Agency.
13. 4:00 Transonic Aerodynamic Characteristics of a Missile Shape with Several Representative Flight Deformations. John P. Mugler, Langley Research Center, National Aeronautics and Space Agency.
14. 4:30 Some Aspects of Magneto-Hydrodynamic Flows. William Grossman, Jr., Langley Research Center, National Aeronautics and Space Agency.

Section Of Geology

FRIDAY, MAY 3—9:00 A.M.

ROOM 324

9:00 Announcements

1. 9:10 Eocene deposits in the Richmond area, with particular emphasis on the engineering characteristics. W. T. Parrott, Virginia Department of Highways.
2. 9:25 Foundation problems with indurated clays. E. H. Ern, University of Virginia.
3. 9:40 Geology and location of economic activity in Clarke and Frederick counties, Virginia. S. T. Emory, Jr., Mary Washington College.
4. 9:55 Stratigraphy and structure of the Damascus area, Washington County, Virginia. J. R. Derby, Virginia Polytechnic Institute.
5. 10:05 Nolichucky trilobites from Decker's graptolite locality at Grafton, Virginia. J. R. Derby, Virginia Polytechnic Institute.

10:15 Break

6. 10:30 Rapid determination of calcium and magnesium in carbonate rocks. D. S. Haglund, Virginia Council of Highway Investigation and Research.

7. 10:45 Mineralogy of some Virginia carbonate rocks. C. S. Sherwood, Virginia Council of Highway Investigation and Research.
 8. 11:00 Petrographic examination of Midlothian coal. J. S. Gillespie, Virginia Institute for Scientific Research.
 9. 11:15 Sheaf-like barite from New Raymer, Colorado. W. E. Workman, University of Virginia.
 10. 11:30 Amethyst locality at Ash Lawn, Virginia. G. H. Gatlin, S. S. Johnson, and R. J. Bland, Jr., University of Virginia.
 - 11:45 Recess
 11. 2:00 Weathering of terrace boulders in Chesterfield County, Virginia: thin-section study. S. B. Cotton and C. I. Rich, Virginia Polytechnic Institute.
 12. 2:15 Weathering of terrace boulders in Chesterfield County, Virginia: mineralogical study. R. I. Barnhisel and C. I. Rich, Virginia Polytechnic Institute.
 13. 2:30 Mineralogy of marbles in the Leesville-Altavista area, Virginia. J. E. Cowlbeck, Virginia Polytechnic Institute.
 - 3:00 Business meeting.
- Saturday, May 4, 1963—Field trip.

Section Of Medical Science

FRIDAY, MAY 3—9:00 A.M.

ROOM 424

1. 9:00 Nicotine absorption from the urinary bladder. J. F. Borbelleca, Medical College of Virginia.
2. 9:15 Hepatic delta-aminolevulinic acid (ALA) synthesis. R. A. Rosser Jr., D. E. Markow and L. D. Abbott Jr., Medical College of Virginia
3. 9:30 Induced alterations in carbohydrate metabolism in *Aspergillus Niger*. E. S. Higgins and W. G. Chambers, Medical College of Virginia.
4. 9:45 Further studies on the distribution of cholesterol in serum. J. C. Forbes and O. M. Petterson, Medical College of Virginia.

5. 10:00 Cardiopulmonary function during acutely induced hypervolemia in anesthetized dogs. R. K. Davis, J. W. Longachure Jr., W. M. Davis, W. J. Wooddell, C. M. Banevjee and S. Said, Medical College of Virginia.
6. 10:15 Lasting effects of low dose X-irradiation on the lens of the mammalian eye. E. R. Berry and E. R. Berry, Medical College of Virginia.
7. 10:30 The influence of prostatic carcinoma on the isozymes of serum lactic dehydrogenase (L.D.H.). G. R. Prout and L. Denis, Medical College of Virginia.
8. 10:45 An enzyme of deficiency in red cells. G. Hilkovitz, Medical College of Virginia.
9. 11:00 The dynamic relationship between body fat, exercise and the fat-free portion of the body. G. C. Pitts, Univ. of Virginia School of Medicine.
10. 11:15 The gas chromatography of the major fatty acids in serum lipid fractions. W. T. Dabney and C. W. Chamberlain, Medical College of Virginia.
11. 11:30 Alteration of soluble retinal proteins in thermal injury. G. Chan, E. R. Berry and W. J. Geeraets, Medical College of Virginia.
12. 11:45 Energy method and measurement for a twelve-year-old girl walking and climbing up and down steps with and without books. S. D. Yu and M. E. Moore, Virginia Polytechnic Institute.

FRIDAY, MAY 3—1:00 P.M.

13. 1:00 An improved method of amidase assay. J. Harris, L. A. Mounter and M. S. Rittenbury, Medical College of Virginia.
14. 1:15 Chemical investigations of the nervous system. N. Papadopoulos, Medical College of Virginia.
15. 1:30 The inheritance of anophthalmia in the Syrian hamster. R. D. Hughes, W. J. Geeraets and M. D. Buraran, Medical College of Virginia.
16. 1:45 Drug induced changes in the C.N.S. response to ionizing radiation. J. L. Oliver and R. H. Brownson, Medical College of Virginia.

17. 2:00 Active ion transport in skins of live frogs. C. C. Watlington, E. G. Huf and A. D. Campbell, Medical College of Virginia.
18. 2:15 The use of insulin and ouabain to elucidate the mechanism of potassium exchange in muscle. D.R.H. Gourley, Univ. of Virginia School of Medicine.
19. 2:30 The sodium and potassium content of adipose tissue and the effect of insulin. M. B. Davidson and D.R.H. Gourley, Univ. of Virginia School of Medicine.
20. 2:45 Biology and a medical curriculum. M. Blair, Medical College of Virginia.
21. 3:00 Electrical response of the retina demonstrating functional injury under light exposure. K. McNeer and W. J. Geeraets, Medical College of Virginia.
22. 3:15 X-ray induced changes in the properties of erythrocyte cholinesterase. L. A. Mounter, Medical College of Virginia.
23. 3:30 Hypobaric in cardiovascular research. T. George and G. Margolis, Medical College of Virginia.
24. 3:45 Propionyl holocarboxylase synthesis. S. C. Huang, D. P. Kosow and M. D. Lane, Virginia Polytechnic Institute.
25. 4:00 Glucose-6-phosphate dehydrogenase activity in the brachial spinal cord of the chick embryo. A. M. Burl III, Medical College of Virginia.
26. 4:15 Comparative study of ageing and ionizing radiation on the rabbit lens. W. T. Ham Jr., W. J. Geeraets, H. A. Mueller, R. C. Williams, F. H. Schmidt, R. S. Ruffin, M. E. Turner, D. Guerry III and R. Maddox, Medical College of Virginia.
27. 4:30 Enzymoelectrophoretic techniques applied to a study of serum enzyme inhibition. P. Darden and M. S. Rittenburg, Medical College of Virginia.
28. 4:45 The electron microscopy of the adrenal gland. M. Sheridan and D. Belt, Medical College of Virginia.
29. The metabolism of rats under various conditions. C. L. Gemmill and K. M. Browning, Univ. of Virginia School of Medicine.
read by title
30. Reactivation of proteases inhibited with organophosphorus compounds. L. A. Mounter and M. E. Mounter, Medical College of Virginia. *read by title*

31. Oxygen consumption in hemorrhagic shock in the cat. E. D. Brand, Univ. of Virginia School of Medicine. *read by title*
32. The effect of several steroidal agents on liver phosphorylase activity. J. A. Thomas, Univ. of Virginia School of Medicine. *read by title.*

Section Of Microbiology

FRIDAY, MAY 3, 1963

PARLOR E

Business Meeting—11:00 A.M.

Scientific Session—2:00 p.m.

1. Vitamin Requirement of *Listeria monocytogenes*. H. G. Welshimer, Dept. of Microbiology, Medical College of Virginia.
2. Genetic and Enzymatic Studies with Identical Site L-arabinose Mutants of *Escherichia coli* B/r. Richard M. Cribbs, Dept. of Biology and Genetics, Medical College of Virginia.
3. Alanine Dehydrogenase and Spore Germination. Neil McCormick, Dept. of Microbiology, University of Virginia School of Medicine.
4. Studies on the Induction of Contact Hypersensitivity in the Guinea Pig. Eugene R. Heise, Dept. of Microbiology, University of Virginia School of Medicine.
5. Identification of *Pasteurella* Species by Immunofluorescence. John D. Marshall, Jr. and P. Arne Hansen, University of Maryland, College Park, Maryland and Department of Microbiology, U.S.A. Medical Division, Fort Detrick, Frederick, Maryland.
6. The Measurement of Antibodies to *E. coli* in Man. Calvin Kunin, Dept. of Preventive Medicine, University of Virginia School of Medicine.

Section Of Psychology

FRIDAY, MAY 3—8:55 A.M.

LOWER EXHIBIT HALL

George W. Kent, Bridgewater College, Chairman

8:55 Announcements

1. 9:00 Serial learning under conditions of prior familiarization with part of the list. Spencer R. Mathews, The University of Virginia.
2. 9:15 Direction of transfer as a function of meaningfulness in paired-associate learning. Philip M. Merikle, The University of Virginia.
3. 9:30 Multiple-choice familiarization and sequential grouping in paired-associate learning. Annette J. Spera, The University of Virginia.
4. 9:45 Some effects of training children to adapt communication to listeners with widely differing requirements. M. Schowalter, The University of Virginia.
5. 10:00 Motor performance as a function of induced tension. Roger W. Fauber, Washington and Lee University.
6. 10:15 Narrated presentation of Melpar film on "The Maze Running Vehicle." L. T. Holland, Jr., Melpar, Inc.

10:30 Recess

7. 10:45 Informal paper and discussion on "Hypnosis: Moral or Immoral?" Bert A. Goldman, Mary Washington College, and other discussants.

12:00 Lunch

Virgil V. McKenna, The College of William and Mary. Chairman

8. 2:00 The independent influence of response frequency upon identification performance. Russell B. Johnson, The University of Virginia.
9. 2:15 Perception of binary patterns with and without reference markers. Nelson F. Smith, Princeton University, and E. Rae Harcum, The College of William and Mary.

10. 2:30 Left-right redundancy and the perception of visual patterns. Bonnie L. Miller, The College of William and Mary.
11. 2:45 The two-dimensional span of apprehension. George Bassett, The College of William and Mary.
12. 3:00 Visual acuity for line-gratings as a bivariate function of retinal meridian and line-orientation. Richard L. Cherry, The College of William and Mary.
13. 3:15 A further study of the effects of repetition on intensity of meaning. Barbara Bryant and Virgil V. McKenna, The College of William and Mary.
- 3:30 Recess
- 3:45 Business Meeting: Psychology Section of the Virginia Academy of Science, including the President's report on the study of high-school instruction in Psychology.
- 5:30 Social Hour and Dinner: Virginia Psychological Association.

SATURDAY, MAY 4—9:00 A.M.

SESSION A—SHENANDOAH ROOM

William M. Hinton, Washington and Lee University, Chairman

14. 9:00 The effect of shock intensity on intracranial self-stimulation in the rat. William M. Durrett, Washington and Lee University.
15. 9:15 Hippocampal stimulation and perseveration theory. John P. Harcourt, Washington and Lee University.
16. 9:30 Effects of hippocampal ablation on shock avoidance behavior. Rodney L. Stump and Philip A. Reidford, Washington and Lee University.
17. 9:45 The effects of history of deprivation on subsequent consummatory behavior. Daniel Fallon, The University of Virginia.
18. 10:00 A test for acquired drive based on the hunger drive. John H. Wright, The University of Virginia.

SESSION B—SHENANDOAH ROOM

Charles L. Fry, The University of Virginia, Chairman

19. 8:45 The Effects of Anxiety on Inverted Alphabet-printing performance. G. A. Gescheider and J. H. Wright, The University of Virginia.

20. 9:00 Relationships among measures of performance for patients diagnosed as having organic brain syndrome. John J. Baldino, The College of William and Mary.
21. 9:15 Early recollections as indicators of personality. R. Vernon Bess and Virgil V. McKenna, The College of William and Mary.
22. 9:30 Parental identification and field dependence—independence. Thomas Coffman and Virgil V. McKenna, The College of William and Mary.
23. 9:45 “Dogmatism” vs. “Rigidity” in perceptual functioning. David Hitt and Virgil V. McKenna, The College of William and Mary.
- 10:00 Recess
24. 10:15 Informal paper and discussion on “The Psychologist as an Expert Witness.” Arthur Centor, Southwestern State Hospital, and other discussants.
- 11:30 Business Meeting: Virginia Psychological Association.

Section Of Science Teachers

THURSDAY, MAY 2, 2:00 P.M.

VIRGINIA ROOM

Mrs. J. J. Thaxton, Jr., Chairman

1. 2:00 Challenging Virginia's Scientifically Talented Youth. Frank Flint, Biology Department, Randolph Macon Woman's College
2. N.S.F. Summer Institute Summaries, Morris Tischler, Fairfax County, David Redfield, Roanoke City, and Cecial W. Nelson, Emory and Henry.
3. Business Session

Section Of Statistics

FRIDAY, MAY 3, 9:30 A.M.

EXHIBIT HALL

9:30 Introduction by Chairman

1. 9:40 Comparison of Two Drugs Using Bayesian Decision Theory.

Armand V. Smith, Virginia Polytechnic Institute.

2. 10:00 Math Model of DNA Synthesis. F. W. Bankhart, University of Virginia Medical College.
3. 10:20 To Be Announced.
10:40 Break
4. 10:50 Non-Parametric Test for 2×5 and $2 \times k$ Tables with Related Frequencies. John T. Blue, Jr., Virginia State College.
5. 11:10 Power Characteristics of Kramer's Method for ANOVA of a Two-way Classification with Disproportionate Subclass Numbers. James E. Dunn and Clyde Y. Kramer, Virginia Polytechnic Institute.
6. 11:30 To Be Announced.
2:00 Introduction of Featured Speaker.
7. 2:15 The Federal Statistical Program: Recent and Anticipated Developments. Raymond T. Bowman, Bureau of the Budget, President of American Statistical Assoc.
3:15 Break
8. 3:30 The Method of Paired Comparisons. H. A. David, Virginia Polytechnic Institute.
9. 3:50 Viability and Estimation of Shelf-Life of Bacterial Populations. Ira A. DeArmon, Jr., Michael D. Orlando, Albert J. Rosewald, Frederick Klein, Albert L. Fernelius, Ralph E. Lincoln, and Paul R. Middaugh, U.S. Army CBR Operations Research Group, Army Chemical Center.
4:10 Business Meeting.

SATURDAY, MAY 4--9:30 A.M.

PARLOR E

10. 9:30 The Sampling Distribution of a Maximum-Likelihood Estimate. Kimiko O. Bowman, Virginia Polytechnic Institute.
11. 9:50 Functional Observations: A Biostatistical Study of Growth. Gary F. Krause, and D. C. Hurst, Virginia Polytechnic Institute.
12. 10:10 Quasi-Rank Correlation Applied to a Selection Problem. Frederic C. Barnett, Virginia Polytechnic Institute.
10:30 Break

13. 10:40 The Use of Orthogonal Statistics with Special Application to the Negative Binomial Distribution. Raymond H. Myers, Virginia Polytechnic Institute.
14. 11:00 To Be Announced.
15. 11:20 To Be Announced.

EXHIBITORS

Ace Glass Inc.

American Optical Co.

American Tobacco Co.

Encyclopedia Britannica Films Inc.

Fisher Scientific Co.

Gardner Laboratories, Inc.

Great Books of the Western World

New American Library

Radio Supply Co., Inc.

Rand McNally and Co.

The Welch Scientific Co.

Will Corporation of Maryland

Aloe Scientific Co.

Addison-Wesley Publishing Co., Inc.

THE ANNUAL SUBSCRIPTION RATE is \$3.00, and the cost of a single number, \$1.00. Reprints are available only if ordered when galley proof is returned. All orders except those involving exchanges should be addressed to Carl W. Allen, Virginia Polytechnic Institute, Blacksburg, Virginia. The University of Virginia Library has exclusive exchange arrangements, and communications relative to exchange should be addressed to The Librarian, Alderman Library, University of Virginia, Charlottesville, Virginia.

NOTICE TO CONTRIBUTORS

Contributions to the Journal should be addressed to Paul B. Siegel, Virginia Polytechnic Institute, Blacksburg, Virginia. If any preliminary notes have been published on the subject which is submitted a statement to that effect must accompany the manuscript.

Manuscripts must be submitted in triplicate, typewritten in double spacing on standard 8 1/2" x 11" paper, with at least a one inch margin on all sides. Manuscripts are limited to seven pages, with the proviso that if additional pages are desired, the author may obtain them at cost. The author may estimate the length of his paper by counting the total number of characters, including blank spaces, and dividing this by 3300. The result is the approximate number of printed pages in the Journal.

Division of the manuscript into subheadings must follow a consistent plan. It is desirable that a brief summary be included in all manuscripts.

Footnotes should be included in the body of the manuscript immediately following the reference, and set off by a dashedline above and below the footnote content. Footnotes should be numbered consecutively from the beginning to the end of the manuscript.

References should be arranged alphabetically according to author. Each reference should include the date, full title of the article, the name of the Journal, the volume and pages. For example: Harvie, L. E. and S. P. Maroney, Jr., 1961. Respiration and hemolysis of ultraviolet irradiated frog erythrocytes. *Va. Jour. Sci.* 12:1-9. References to the bibliographic citations should not be made by numbers. Instead, using the above citation, where a reference is desired: either (Harvie and Maroney, 1961) or Harvie and Maroney (1961).

Explanation of graphs and tabular material should be typed on separate pages. All figures should be numbered consecutively beginning with the first text figure and continuing through the plates. If figures are to be inserted in the text this should be indicated at the appropriate place in the margin.

Illustrations including lettering, should be arranged so that on reduction they will not exceed the dimensions of the maximum size of a printed page. Large plates must be accompanied by photographic copies which can be sent to the reviewers. The Journal will furnish the author with one plate or its equivalent; additional figures, colored illustrations or lithographs may be used only if the author makes a grant covering the cost of production. Original drawings (which must be done in black drawing ink) not photographs of drawings, should accompany the manuscript. When photographic prints are used they should be glossy, sharp and show good contrast. Drawings not neatly executed and labeled (do not use a typewriter), or which are not submitted on white paper will not be accepted.

Galley proofs are sent to the author for correction. Costs of excessive changes from the original manuscript must be defrayed by the author.

OFFICERS OF THE VIRGINIA ACADEMY OF SCIENCE

Jackson J. Taylor, *President*
Foley F. Smith, *President-Elect*
Paul M. Patterson, *Secretary*
Rodney C. Berry, Sr., *Treasurer*
William B. Wartman, *Assistant Secretary-Treasurer*

COUNCIL

P. A. Hansen	E. D. Brand	B. Harshbarger
H. G. M. Jopson	J. L. Calver	Suzie V. Floyd
G. T. Miller, Jr.	J. M. Grayson	E. F. Turner, Jr.
S. B. Row	S. B. Williams	H. Leidheiser, Jr.
P. B. Siegel	R D. Hughes	W. W. Scott

505.73
~~V81~~

Q
1
52
N4

THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE



Vol. 14, New Series

July, 1963

No. 3



VOL. 14, NEW SERIES

No. 3

JULY, 1963

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND
SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

Printed by the Bassett Printing Corporation, Bassett, Virginia

C O N T E N T S

	<i>Pages</i>
<i>Dictyota dichotoma</i> in Virginia. Harold J. Humm	109
Determining Resources Needed in Virginia Agriculture in the Years Ahead. Carl W. Allen	112
The Nesting of the Many-Lined Salamander in the Dismal Swamp. J. T. Wood and R. H. Rageot	121
The Generic Significance of the Buccal Infraciliature in the Family Tetrahymenidae and a Proposed New Genus and Species, <i>Paratetrahymena wassi</i> . J. C. Thompson	126

EDITORIAL BOARD

Paul B. Siegel, *Editor*

Carl W. Allen, *Managing Editor*

SECTION EDITORS

W. P. Anslow, Jr.

C. Y. Kramer

W. T. Parrott

D. R. Carpenter, Jr.

A. Mandell

F. B. Rowe

P. A. Hansen

N. F. Murphy

G. W. Thomas

M. A. Kise

J. C. Thompson

Entered as second-class matter at the post-office at Bassett, Virginia and Blacksburg, Virginia, under the Act of March 3, 1897. Subscription \$3.00 annually. Published four times a year: in January, April, July and September by the Virginia Academy of Science at Blacksburg, Virginia.

Mailed August 6, 1963

THE VIRGINIA JOURNAL OF SCIENCE

VOL. 14, NEW SERIES

JULY, 1963

No. 3

DICTYOTA DICHOTOMA IN VIRGINIA

HAROLD J. HUMM¹

Department of Botany, Duke University, Durham, North Carolina

(Received for publication September 10, 1962)

Hoyt (1917-1918), in his excellent work on the marine algae of Beaufort, North Carolina, pointed out that this area is a transitional one between northern and southern algal floras of the Atlantic coast of the United States. Of the 84 genera he reported for the Beaufort area, 24 genera and 46 species reached their northern known limit there, while 4 genera and 9 species reached their southern known limit at Beaufort. Subsequent publications by others have added considerably to the numbers of both groups.

Marine algae reaching their northern known limit in the Beaufort area (Cape Hatteras?) are present in the vegetative state mainly from May 15 to November 15 if they occur in the bays and sounds. If they occur offshore on the continental shelf in depths of 50 to 300 feet or more, they seem to be present the year around in a growing condition, as the offshore water temperatures fluctuate much less with season than do those of the bays and sounds.

One of the most abundant and conspicuous members of the inshore summer flora at Beaufort is *Dictyota dichotoma* (Hudson) Lamouroux. It appears annually about April 15 and disappears about November 15. There is annual variation in these dates of about two weeks, but they seem to represent an average. The genus *Dictyota* is essentially tropical. Taylor (1960) lists ten species known to occur around southern Florida, the West Indies, and Caribbean Sea. *D. dichotoma* is the species reaching farthest north in both the eastern and western North Atlantic and in the Gulf of Mexico. In the eastern Atlantic it occurs along the coasts of southern and western England and Ireland, and is occasional along the coast of eastern

¹Visiting Scientist, Virginia Institute of Marine Science of 1962.

Contribution from the Virginia Institute of Marine Science No. 119.

England and Scotland (Newton 1931). It is the one species that reaches the northern coast of the Gulf of Mexico where the salinity is sufficiently high (above 20 0/00), as in Alligator Harbor, south of Tallahassee, Florida. In the eastern Atlantic the species seems to occur in cooler waters in summer than it does along our own coasts of the western Atlantic.

On July 10, 1962, quantities of *Dictyota dichotoma*¹ were found attached to shells and drifting along the marshes east of Wachapreague on the Eastern Shore of Virginia. The species seems well-established in the area and may have been a constituent of the summer flora there for a long time. This is about 200 miles farther north than its previously known northern limit, but collections of algae along this section of the coastline have been so few in the past that it could easily have been missed. If its occurrence along the Eastern Shore of Virginia is an annual event, then it is a species that crosses the Beaufort transitional zone.

REFERENCES CITED

- Hoyt, W. D. 1917-1918. Marine algae of Beaufort, North Carolina, and adjacent regions. Bull. Bureau Fish. (U. S.) 36:367-556.
- Newton, Lily. 1931. Handbook of British Seaweeds. Brit. Museum, London, 478 p.
- Taylor, W. R. 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. Univ. of Mich. Press, Ann Arbor. 870 p.

¹Specimens have been deposited in the herbaria of the Virginia Institute of Marine Science and of Duke University.



FIGURE 1.

A mature plant of *Dictyota dichotoma* from Hummock channel near Wachapreague, Virginia, July 16, 1962. The plant was about 11 inches tall and attached to an oyster shell in shallow water. Photograph of a specimen deposited in the herbarium of the Virginia Institute of Marine Science.

DETERMINING RESOURCES NEEDED IN VIRGINIA AGRICULTURE IN THE YEARS AHEAD¹

Carl W. Allen²

(Received for publication November 15, 1962)

The purpose of this paper is to point out why this particular type of research is being undertaken and also to discuss a little how it is being undertaken. Under why, such things as what prompted the research and the importance I attach to it will be discussed. In the part dealing with how, I will discuss the methodological procedures which represent my thinking to date.

Behind all research there must be some motivating force. This force might be idle curiosity, in the interest of pure science, to meet these requirements, for profit (writing a book), or we might be hired by a public or private agency to do research. In this latter category are several hundred full-time research workers in our land grant college system and the United States Department of Agriculture. If I had to make one statement typifying current research of the land grant college system as well as the United States Department of Agriculture, I would say that it was output increasing. True, there are some exceptions and some of it is necessary to stay where we are and not lose ground.

A typical research project "discovers" that by using 3 of x and 2 of y, we get 8 units of output; while present use is 2 of x and 3 of y, yielding only 7 units of product. The proportions are immaterial for our discussion here, the relevant point being that with the same resources we get more total product with some new combination. Or instead of a new combination being "discovered", the project might develop higher yielding breeds of animals or varieties of plants. The end result is still that the total output is increased with the same quantity of resources. It makes little difference that demand might not exist for the greater output. The individual resource owner wants to maximize profits and he can usually do this best by keeping all of his resources busy. He seldom voluntarily leaves resources idle. Soon, some other group of producers would like to receive help in the form of concentrated research on their problem. This

¹This statement is based in part on a paper given before the Virginia Social Sciences Association annual meeting, 30 April 1960, Petersburg, Virginia.

²The author is presently Professor of Economics, School of Business, Virginia Polytechnic Institute, Blacksburg, Virginia.

would be true even though one might be producing corn and the other wheat because of the great amount of substitutability between products. It doesn't take long for us to see that we are going around in a circle. We help one group get ahead—then we help another to catch up **and so on**. Does this mean that research should be stopped? I am sure that most of us could agree that we would answer this with an unqualified no. It does however, point toward changing some of our traditional concepts and the direction of research. For example, our acceptance of resource efficiency criteria wherein both society and the individual will be better off if resources are combined in some optimum manner and, the principal basis on which most of our research in agriculture is justified, is predicated on perfect competition and the free movement of resources from use to use. Today, we have neither of these conditions and I might say parenthetically that we haven't had for many years. It is doubtful if we can continue on our present way blindly and ignore the restrictions on resource movement imposed by government and lack of knowledge.

The really crucial task here involves the goals of research and following that, the selection of problems to research on. We cannot possibly have enough research workers to devote major efforts to every group of producers (or consumers or processors, etc.) In other words, how do we decide which problem to investigate? Speaking for the social sciences primarily and in my own specialty, I would suggest that today we are "pressured"—perhaps indirectly—into researching on particular things. Under our present system of problem selection we have no real criteria to guide us—except mostly the "squeaking wheel gets the grease".

At the expense of being repetitious, I would like to mention a couple of other studies or types of research effort. Society, through the Congress, has decided that the tobacco farmers' income should be raised (or maintained) and is spending "our" money to put in controls and to maintain prices; but another arm of society is trying to show the individual tobacco producers how to beat the game. Consider for a moment how much research effort is underway to show tobacco farmers how to get more pounds of tobacco per allotted or controlled acre. Is there any justification for these two diverse and conflicting uses of "our" money? How does the goal of this research worker fit into any scheme or goal of society on efficient use of the total resources?

Another popular type of study recently has been the adjustment study. I have been unable to determine precisely what these studies are doing. What will be adjusted and to what? Will output be adjusted to some pre-conceived level? Or is it again in the context of adjusting to "efficient use of resources." I would say that most of the studies are framed in such a manner that one must conclude that the real goal is to use efficiently all resources presently in agriculture in the continued production of agricul-

tural products. In other words, study the trends or program a sample of farms for optimum resource use and make predictions that we will have so much production forthcoming and that we must take action to dispose of the excess over domestic demand or find new uses for the products. Recently I saw the finished result of a five-year study on the soybean market. In a nutshell, the conclusion reached was that because soybean production capacity in the United States had expanded faster than our ability to consume at home, we must expand our export market!

I cite these examples not in the sense of being derogatory of my colleagues but to show why I would like to break somewhat with the past in the manner that I am trying to do. I believe we need a revolutionary change—some kind of a “fair deal”—in our research. I would like to blame the system which we presently are more or less forced to follow in the selection and conduct of research rather than the individuals. As a result of the system, I think that much of the past work has been so transitory in nature that the solution is outdated before the work is finished. In other words, the question asked originally to prompt the research is no longer a propos. And, while being critical, let me say also that at least a part of the past work, and this includes my own, has been fragmentary or piecemeal, and incomplete when viewed from an aggregate standpoint. This again indicates the need for broader, more forward looking studies to prevent being “boxed-in” as we have in the past by working in compartments. In concluding this portion, let me say that in spite of my unkind remarks, much very worthwhile research in the field of agriculture has been and is being done. The inescapable conclusion is, however, that the most pressing problem—that of income in the agricultural sector—is still with us and, like our teenagers, still growing.

Now then, if I have not dwelt too long on the past in a negative frame of mind, let us look briefly at what I am trying to do and how I am attempting it. To start the revolutionary change I am starting in the future and working backwards. You might say that I am working on the other side of the equal sign. In place of determining that amount of land, amount of labor, and amount of capital, usually the quantity presently used, will produce amount of y (product). I want to start with y given, then determine how much land, labor, and capital will be needed. The difference here being in the selection of dependent and independent variables. In place of finding or attempting to find ways to keep all our resources in agriculture busy and possibly (more likely probably) attract additional capital in the process, I would like to see just how few resources we can get by with ten years from now. Stated in this manner, I believe such a goal would be acceptable to most thinking people—rural and urban alike.

Now then, how might we realistically set out to determine the re-

sources needed in Virginia agriculture in the years ahead? The first step is to build a model. Since this is only on paper, we can let our imagination run. We might never be able to obtain the data called for by the ideal model, but in the interest of scientific objectivity, we should describe the ideal model anyway. All the relevant variables would be allowed for or taken into consideration. What we are really doing is describing the structure of Virginia agriculture so precisely that the effect on total production (output) of moving one dollar into or out of agriculture could be measured. Or we could evaluate the development of a new higher yielding hybrid that would be available in quantity in 1964 with the amount used specified. Some of the variables are obvious such as acres of land, days of labor, and capital in various forms. There are many others—some measurable and some rather vague. The rate of development and adoption of new techniques in the base period selected for deriving our structural relationship is a very important variable. Weather is one of the rather vague variables in the sense that it is difficult to measure but is important in its effect on the productivity of resources.

Why not take only one year like 1960 or 1959, inventory the resources used, and measure the output? This would be one place to start, but it is very incomplete. Aside from year to year variations caused by the vagaries of weather and other forces, it is difficult to see where to go with this information, exact though it may be. This is primarily because we are faced with change in (a) rate of adoption of newer techniques and (b) quantities (and forms) of resources. It might be possible to make subjective estimates on the rate of adoption of newer techniques as they become available and, in fact, this would possibly be necessary to some extent under any scheme of estimation; but to handle the change in quantities of resources and their effect on output becomes extremely difficult without some measure of the coefficients of production for production for particular resources. The same fault essentially can be found with merely projecting trend lines. In addition to getting much more specific than is desirable in an aggregate study of this nature we have no way to evaluate counteracting trends.

It seems desirable, then, to derive some estimates of the productivity of the different resources even though these productivity estimates may be "gross". This means that we must inventory resources used for each of a period of years in the past and measure the output resulting from the use of the resources for each of these years. We do not have to concern ourselves at this point with whether or not this was the "best" use for the different categories of resources over the time period selected. Viewed *ex post*, we might determine that this was not the "best" use of resources, but it may have been when viewed *ex ante*. If we can find adequate data to derive the coefficients of production in accordance with our perfect

model, our problem would indeed be simple. That is, if we accept a possible method which I am going to suggest for deriving the "demand"¹ at some point in the future, all we would need to do would be to set the demand in our equation, put the whole thing in one of the newer electronic computers, and press the button; and quick as a wink we would have our answer on resources needed.

This brings us up to the demand picture, and I recognize that we must make many assumptions on expected demand at some date in the future. This is not quite as hopeless as it seems, however, considering the relative nonelasticity of the human stomach. For a particular product of agriculture, I would not even attempt to predict the quantity which would be consumed at some future date, but the aggregate consumption of products from agriculture in 1968 by possibly 200 million people will be about 11% greater than the consumption by 180 million people. Obviously this depends upon and assumes no drastic change in the level of economic activity. You might be thinking that this is fine for the entire United States, but what about one of the 50 states—Virginia? Our sociology friends study population trends and can give us reasonably good figures on numbers of people to expect in specified years. Using these population estimates, is it too unrealistic to assume that Virginia's pro rata share of the entire demand picture will be about the same 10 years in the future? If we can show (or assume) that it might be approximately the same, this will provide the basis for making the first approximation of products needed¹ which in turn specifies the resources needed with today's techniques and no change in the adoption rate. Where the adoption rate of an innovation is dependent upon capital, we might have to modify our estimates considering the competition with other uses of capital. This is another step in the study.

Getting back to estimating "demand" for agricultural products 10 years from now, is there any reason to expect the competitive position of Virginia agriculture to change relative to that of other agricultural producing regions? I see no major break-through in research on the horizon that might change the relative comparative advantage between regions. In the absence of evidence to support the hypothesis that Virginia's competitive position will be enhanced or decline, I am willing to conclude that it will remain about as is.

As we move nearer our target date, another look at the forces at work in determining how or where resources will be used will permit a refinement of our estimates.

¹The quantity of agricultural products "needed".

²Needed could be defined in several ways: adequate diet nutritionally for everyone, non-hunger for anyone, or what will move in the market place.

I think that it is well to re-emphasize that this study is dealing with aggregates. It is not intended to be a precise guide for any individual producer or group of producers in making short-run decisions. Perhaps the most we will ever be able to do is to show the direction which certain of the resources should move for the greatest efficiency of Virginia's total resources. While the results might indicate that a considerable quantity of resources (like labor) should move out of agriculture, this would in no way tell an individual that he was the chosen one to leave. It might put him on guard that if he intended to stay in agriculture that the going could get rough in the years ahead. I would like to think that policy makers would be interested in a critical analysis of the resources needed in the agricultural sector of Virginia.

I am not far enough along to make any prediction on the success or failure of this work. It probably goes without saying that one would be safer in making an estimate of resources needed 20 or 30 years from now than in making one for only the near future—ten years.

Now for a few comments on what I have been able to accomplish to date. The model building is not complete but in its simplest aspect has gotten to the stage of specifying that total output (measured as an index of the physical volume of production perhaps or the simple value of the output measured in current dollars) is a function of (1) labor (man years), (2) working capital (dollars spent for seed, feed, fertilizer, and the like; also dollars invested in livestock, machinery, and equipment but not land and buildings), (3) acres of cropland (with a quality index), (4) an index of technology, and (5) a weather factor. Compilation of one and two for the period 1949-1958 is almost complete or the source of the data and the availability is known. Total acres of crops grown in Virginia are available for 1949, 1954 and 1959 from census data. Estimates for each of the years between need to be developed further. A qualitative index for each of the years 1949 through 1958 based on the year of 1958 from the conservation needs inventory using the capability units should now be possible. Four and five will require considerable more work—almost complete research projects in themselves.

As a cursory check on the validity of this procedure in general, a sample analysis relating input to output was accomplished. Using current dollars to measure output (farm production)¹ as the dependent variable and current operating expenses² as the independent variable for the 10 year period 1949 to 1958 for Virginia a significant linear relationship apparently exists ($Y=80+1.43X$ with an r value of .64). Correcting the

¹Farm Income Situation, U. S. Department of Agriculture, September, 1959 (Table 4).

²Production Expenses of Farm Operators by States, 1949-1958, AMS-85, October, 1959.

Table 1. Receipts and Expenses for Virginia Farms 1949-1958

	Expenses ¹ \$ (million)	Receipts ² \$ (million)
1949	230	399
1950	240	440
1951	269	524
1952	295	521
1953	276	430
1954	276	468
1955	269	456
1956	280	495
1957	278	417
1958	287	505

¹Feed, livestock, seed, fertilizer and lime, repairs and operation of capital items, miscellaneous and hired labor.

Source AMS-85 October 1959

²Cash receipts from farm marketings plus government payments, and plus or minus inventory increase or decrease.

Source: Farm Income Situation, September 1959

Table 2. Index of Prices Paid and Received by U. S. Farmers.
1949-1958

	Index of Prices Paid all Production Items (1910-14=100)	Index of Prices Received for all Farm Products (1910-14=100)
1949	238	250
1950	246	258
1951	273	302
1952	274	288
1953	256	255
1954	255	246
1955	251	232
1956	250	230
1957	257	235
1958	264	250

Source: Agricultural Prices. AMS

output by an index of prices received³ and using the total cost of production corrected by the index of prices paid² as the independent variable continues to yield apparently significant results ($Y=90.6+1.47X$ with an r value of .57). No allowance or consideration is made in the above for weather or technology. The changing (generally less) quantity of hired labor is accounted for in current operating expenses. Family workers and acres of crops were both down in 1958 from 1949 and at a rather constant decline during the years. In spite of leaving out of this simple analysis several important variables, it appears that sufficient positive relationships exist to warrant further work on the general model.

If coefficients can be determined from the general model, we will see if the first part of the base period 1949-1958 can be used to predict later parts of this period. If this prediction can be made, it will give us much greater confidence in the coefficients of production. If we cannot make this prediction, then of course we will try to sharpen up our estimates; and it would indicate that either our observational errors were great or that we had omitted some important variable or variables.

It was visualized from the beginning that this work would be tied in with and complement that of other economists studying problems of businesses in general and that the total use of resources in Virginia will be improved without regard to particular producing segments.

Table 3. Total, Family and Hired Workers on Virginia Farms 1949-1958

	Total Workers (Thousands)	Hired Workers (Thousands)	Family Workers (Thousands)
1949	288 ^a		
1950	283	69	214
1951	264	64	200
1952	258	63	195
1953	242	59	183
1954	240	60	180
1955	232	58	174
1956	216	55	161
1957	209	53	156
1958	214	57	157

^a1949 data not available in this series and the 288 is estimated by the straight line method.

Source Farm Employment, Statistical Bulletin, Number 236, U. S. Department of Agriculture (AMS), September 1958, supplemented by monthly publication "Farm Labor" of AMS.

³Compiled from **Agriculture Prices**, AMS.

Table 4. Acres of Crops and Pastures, Virginia 1949, 1954 and 1959

	Acres	
	Crops (Thousands)	Pasture (Thousands)
1949	3,305	3,936
1954	3,158	3,888
1959	2,918	3,570

Source: U. S. Census of Agriculture

THE NESTING OF THE MANY-LINED SALAMANDER IN THE DISMAL SWAMP

J. T. WOOD¹ AND R. H. RAGEOT²

(Received for publication, December 14, 1962)

The Many-lined Salamander (*Stercochilus marginatus* Hallowell) has been known for more than 100 years, yet most of the details of its life history remain unknown. Observations on 43 nests collected in the Dismal Swamp in Virginia, in 1954 and 1955, are reported here.

The discovery of nesting of this secretive species has only been reported twice in herpetological literature and, in each of these reports, a single nest has been described. The first nest was collected on March 27, 1954 in Beaufort County, North Carolina. A female was found beneath a log, lying in moist sand at the edge of a flooded pit, beneath a group of 15 eggs that were "pedicellated, definitely drop-shaped, and attached firmly to the underside of the log" (Schwartz and Etheridge, 1954). The second nest was collected on January 27, 1951 (Rabb, in 1956) in Berkeley County, South Carolina, in a pond surrounded by gum trees (*Nyassa biflora*). "Inside a very mushy gum log, the bulk of which was situated above the water near one side of the pond, a large female . . . was found curled about a mass of approximately 40 eggs. There were about 20 other eggs nearby—a total of 62 eggs in all." In both of these nests, eggs were found out of water.

From February 27 to April 7, 1954, 35 nests were collected in ponds near Jericho Ditch, Nansemond County, Virginia. In contrast with the cases described in the literature, these egg groups were all submerged. In 31 nests, the eggs were suspended from the rhizoids and stems of the water-moss *Fontinalis*. These nests were in stagnant pools of dark brown swamp water (pH 5.2) in a gum and cypress forest. The eggs were attached to their supports by the adherent surface of the egg-envelope in the same manner as in nests of the Two-lined Salamander (*Eurycea b. bislineata* Green); there was no "common" or outer envelope for the entire egg group as is found in nests of Northern Dusky Salamanders (*Desmognathus f. fuscus* Rafinesque). Attachment of the eggs to tiny stems, pine needles, and rootlets (Figure 1) was surprisingly similar to attachment in *Eurycea b. bislineata* nests in southeastern Virginia (Wood, 1953). There was one rather constant differentiating characteristic, the adherence of

¹University Hospital, Ann Arbor, Michigan.

²Norfolk Museum of Arts and Sciences, Norfolk, Virginia.

Stereochilus eggs to one another as in Four-toed Salamander (*Hemidactylum scutatum* Schlegel) nests. *Hemidactylum* eggs are always found above water in our field experience, and have not been reported in submerged situations in the literature, and they are more compactly grouped than *Stereochilus* eggs. Examples of this adherence between various numbers of eggs (2, 3, 5) is illustrated in Figure 1, and also the lineal disposition pattern of the eggs.

A distinct difference in preference for nesting sites is noted between *Stereochilus* and *Eurycea*. The former select quiet stagnant swamp pools, and the latter choose shallow areas of clear running water. Larvae of both species have been collected in the same traps in ditches just beyond the periphery of the swamp near Craddock, Norfolk County.

These 35 nests were all found in shallow water from three to six inches beneath the surface. The *Fontinalis* growths that contained the eggs were attached to the pond bottoms by rather few slender rootlets. Habitats were heavily forested and in deep shade most of the time; this, and the dark color of the water, undoubtedly served to protect the nests from the vision of predatory species.

There are other distinctive differences in the arrangement of *Stereochilus* and *Eurycea* nests. In the former, the eggs are in irregular groupings, often several discrete small groups of three to six eggs and a number of solitary eggs; in the latter, the eggs are arranged in a very compact, orderly distribution (Wood, 1953). The survival of the embryos may be enhanced by the more widely distributed eggs in the *Stereochilus* nests, for the carbon dioxide level in swamp waters is higher than in moving spring waters. Lack of water turbulence would reduce the conveying of metabolic wastes from the eggs.

The remaining four nests collected in the 1954 series were also found submerged but were not attached to growths of *Fontinalis*. Three of them were found suspended from the undersides of logs. Two of these nests were in areas of heavy peat moss (*Sphagnum* s.) growths, but none of the eggs were found in the moss. This is in distinct contrast to nests of *Hemidactylum* eggs which are very often found in *Sphagnum* (Wood, 1955). The fourth egg group was suspended from a cane twig in the middle of a *Fontinalis* growth.

In the first 35 nests, only two adult specimens were found near the nests; neither was in contact with an egg group when discovered. These females were preserved and dissected, and their ovaries were devoid of large ova, suggesting they had spawned recently. Whether or not they were attending egg groups could not be determined due to the difficulty observ-

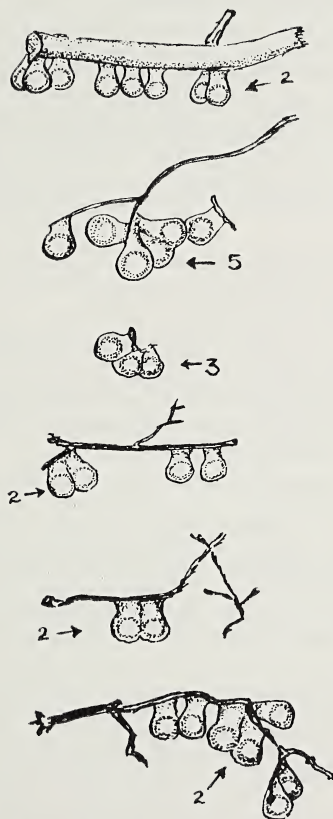


FIGURE 1. Typical lineal arrangements of adherent eggs of *Stereochilus marginatus* suspended from stems, rhizoids, and twigs. Numbers indicate adherent groups of eggs.

ing through the dark water and the mud-swirls stirred up when the masses of *Fontinalis* were pulled from the ditch.

The nests collected in 1955 were all found above water! Eight nests were found on April 2nd and 3rd. All were in *Fontinalis* clumps within a few inches of water. The season had been unusually dry, and without doubt, one average rainstorm would have raised the water-level in the ponds, submerging the nests. In three nests, the embryos were in late gastrula stage, and development had not proceeded far beyond this point in the other five. In 1954, eggs in this stage of development were found one month earlier. Two adult females were collected with these nests and both had spawned all large ova. Neither had *Stereochilus* eggs in stomach or intestines.

Nests collected in 1954, contained a total of 1,309 eggs, averaging 37 eggs per nest (range: 6 to 92); nests in 1955, contained a total of 173 eggs, averaging 22 eggs per nest (range: 9 to 45).

The surface of the egg envelopes of the eggs collected in 1955 were covered with tiny fragments of debris in the manner of *Hermidactylum* eggs. This suggests that they were desposited above water, and while still moist and sticky were exposed to tiny particles in the dry rootlets. The eggs in nests collected in 1954 had little debris attached to their surfaces, suggesting that they were deposited beneath water.

Induction of egg-laying in *Stereochilus marginatus* was reported by Noble and Richards (1932). They used pituitary transplants and succeeded in causing 19 females to deposit some eggs. Most eggs were deposited under water, but some were laid along the water margin or on land. After this experiment the females were preserved and dissected, and numbers of large ova were found still in their oviducts and ovaries. On the basis of the number of eggs laid and the complements of large ova, they estimated an average nest would contain 70 eggs (range: 16 to 121).

The implication in the above work was that the species would simulate its normal breeding and nesting behavior under this hormonal stimulation. Work undertaken with George Cavros, at the University of Virginia, suggests that the behavior is distinctly atypical, and not of much value in predicting the behavior of species. In any event, Noble and Richards provided their habitats with stones whose submerged undersides were elevated from the terrarium base, and nesting took place on these rocks. No eggs have been found attached to rocks in the Dismal Swamp in the present survey.

SUMMARY

1. Nests of *Stereochilus marginatus* were found submerged in 1954, above water in 1955.
2. Most of the nests were in growths of the water-moss *Frontinalis*.
3. Few adult females were collected with the nests. Whether they attend nests as consistently as many other species of *Plethodontidae* salamanders could not be determined.
4. Nesting in the dry season in 1955, apparently took place one month later than in the wet season in 1954. Nests were found from February 27th through April 7th.
5. Average number of eggs in 35 nests collected in 1954: 37 (range: 6 to 92); in 8 nests in 1955: 22 (range: 9 to 45).
6. Eggs were found individually suspended by their outer envelopes, yet frequently adherent to adjacent eggs.
7. Nests found above water contained eggs whose surfaces were studded with tiny particles; those beneath water lacked these surface particles.
8. Abhence of nests in *Sphagnum*, in spite of its abundance beside the swamp pools, suggests some striking difference in nesting behavior between *Stereochilus* and *Hemidactylium*.

LITERATURE CITED

- Noble, G. K. and L. B. Richards, 1932. Experiments on the egg-laying of salamanders. *Novitates, Am. Mus. Nat. Hist.*, (513): 1-25.
- Schwartz, Albert and Richard Etheridge, 1954. New and additional herpetological records from the North Carolina coastal plain. *Herpetologica* 10:167-171.
- Rabb, G. B., 1956. Some observations on the salamander, *Stereochilus marginatus*. *Copeia* (2): 119.
- Wood, J. T., 1953. The nesting of the two-lined salamander, *Eurycea bislineata*, on the Virginia coastal plain. *Nat. Hist. Misc.*, Chi. Acad. Sci. (122):1-7.
- Wood, J. T., 1955. The nesting of the four-toed salamander, *Hemidactylium scutatum* (Schlegel), in Virginia. *Amer. Midl. Nat.* 53: 381-389.
- Wood, J. T. and M. E. Fitmaurice, 1948. Eggs, larvae, and attending females of *Desmognathus f. fuscus* in southwestern Ohio and southeastern Indiana. *Amer. Midl. Nat.* 39: 93-95.

THE GENERIC SIGNIFICANCE OF THE BUCCAL
INFRACILIATURE IN THE FAMILY
TETRAHYMENIDAE AND A PROPOSED
NEW GENUS AND SPECIES,
PARATETRAHYMENA WASSI¹

JESSE C. THOMPSON, JR.

Hollins College, Hollins College, Virginia

(Received for publication January 5, 1963)

The hymenostome holotrich family Tetrahymenidae was erected by Corliss (1952) to relieve, in part, the heterogeneity of Kahl's (1930-1935) family Frontoniidae. It was characterized chiefly by a tetrahymenal buccal apparatus consisting of an undulating membrane on the right edge of the buccal cavity and three membranelles which occupied the floor and left wall of the oral cavity. At that time the following genera were included as unquestionable members of the family: *Tetrahymena*, *Colpidium*, *Glaucoma*, *Deltopylum*, and *Loxocephalus*. Three other genera, *Monochilum*, *Dichilum*, and *Lambornella*, were considered as likely candidates. Stout (1956) rediscovered and added the genus *Sathrophilus* Corliss, 1960 (= *Saprophilus* Stokes, 1887) which Corliss (1952) considered as an involved genus. Later Corliss (1961), in listing again the genera of the family, included *Tetrahymena*, *Sathrophilus*, *Loxocephalus*, *Colpidium*, *Glaucoma*, *Deltopylum*, *Dichilum*, *Monochilum*, and *Stegochilum*. An additional genus, *Platynematum* has since been added by Borror (1962).

It is the purpose of this paper to review the genera of the family Tetrahymenidae, with particular emphasis on the buccal infraciliature, and to propose the addition of a new genus, *Paratetrahymena*, to this family.

MATERIALS AND METHODS

The ciliate being described as a new genus and species appeared in a culture made from bottom sediment collected in the York River, near the Virginia Institute of Marine Science at Gloucester Point, Virginia. Clonal

¹The investigation was supported in part by Grant G20851 from the National Science Foundation and by National Science Foundation Grant G15445 for Research Participation for College Teachers during the summer of 1961 at the Virginia Institute of Marine Science, Gloucester Point, Virginia.

Virginia Institute of Marine Science Contribution Number 131.

cultures of this brackish-water ciliate were established in a medium consisting of autoclaved river water and *Ulva* (sea lettuce). Phase microscopical observations were made on the living organisms and light microscopical studies were made on animals stained by the Chatton-Lwoff method of silver impregnation (Corliss 1953b). Nuclear preparations were stained with haematoxylin.

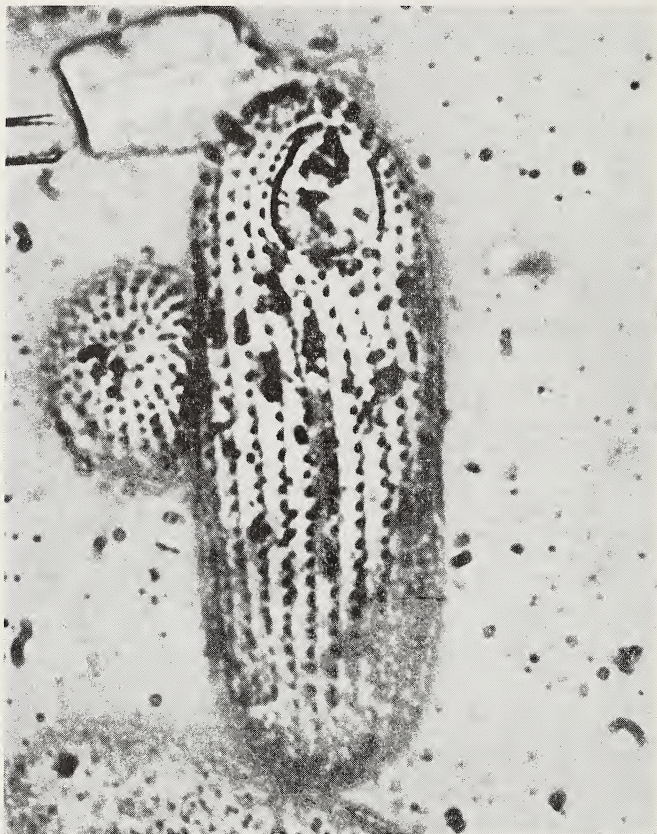
Morphology of *Paratetrahymena wassi* n.g., n. sp.²

Body Form and Size. The body is generally elongated with a rounded posterior and bluntly pointed anterior end. The body is very flexible and in mass cultures the ciliates commonly assemble in clusters on the bottom of the petri dish to feed. While feeding, the anterior end moves in a series of short quick movements. The average size of 70 silver impregnated animals was 55.8 x 22.2 micra. The animals generally seem more elongated in the living cultures, so apparently there is some shortening at fixation. The age of the cultures also seems to influence the length-width ratio. In older, well-fed cultures, the animals appeared wider than in younger dividing ones.

Ciliary Meridians. The number of ciliary meridians vary from 22-26 and are rather evenly spaced. The second meridian (the meridians are numbered clockwise, following convention, (see Corliss, 1953a) continues anteriorly around the right side (animal's right) of the buccal cavity and ends just in front of the anterior edge of membranelle one (Fig. 1). In silver impregnated animals, the anterior end of this meridian consists of about 7-9 granules more closely set than the remaining granules of the meridian. Meridian number one and the last two meridians terminate posterior to the buccal cavity (Fig. 1). The third from the last meridian (N-2) runs around the left side of the buccal cavity and ends near the posterior end of membranelle one. In silver impregnated animals, this meridian, from about the level of the posterior end of the buccal cavity, consists of about 12-17 closely set granules (Fig. 2). In living animals these granules were observed to possess cilia, but these cilia did not seem to function as a membrane. All the remaining meridians continue anteriorly and end to form a rather clear loop-shaped area. Occasionally, a silver stained granule or two are present within this area. The basal granule complexes of the anterior ends of the meridian are closer together. Posteriorly the meridians end irregularly at the caudal pole. A caudal cilium is present, its infraciliature represented by a polar basal granule-complex (Holz and Corliss, 1956).

The generic name *Paratetrahymena* was chosen for this ciliate because of its general similarity to the genus *Tetrahymena*. The specific name *wassi* was chosen to honor Dr. Marvin L. Wass of the Virginia Institute of Marine Science who supplied the original culture from which this ciliate was isolated.

Buccal Cavity and Buccal Apparatus. The buccal cavity is broadly pyriform to oval in shape and located very near the anterior end (Fig. 2) It



EXPLANATION OF FIGURE I

Paratetrahymena wassi. Ventral view of silver impregnated animal.



FIGURE 2



FIGURE 3



FIGURE 4



FIGURE 5

EXPLANATION OF FIGURES 2, 3, 4, 5.

Ventral views of silver impregnated animals. Fig. 2. *Paratetrahymena wassi*. Fig. 3. *Tetrahymena*. Fig. 4. *Colpidium*. Fig. 5. *Glaucoma*.

measures about 11.0×8.5 micra. It is very shallow anteriorly and deepens posteriorly. The undulating membrane (UM) measures about 8.9 micra and runs along the right side of the buccal cavity. It terminates opposite the anterior end of membranelle number two. In silver impregnated specimens it appears as closely set row of granules (Fig. 2). A few scattered granules are present along the posterior edge of the buccal cavity but it is not clear whether these are a part of the UM or just granules of the three post-oral meridians. The so-called UM striations (Corliss, 1953a) run down into the buccal cavity. These begin about opposite membranelle three and continue around and along the posterior edge. Three membranelles occupy the floor of the buccal cavity and extend upon the right wall close to the UM (Fig. 2). Membranelle one (M_1) and membranelle two (M_2) are present in the anterior half of the buccal cavity while membranelle three (M_3) lies near or posterior to the center. M_1 is irregularly rectangular in shape and measures approximately 3.6×1.6 micra. The anterior end seems to be wider. M_2 is irregular elongated with a short posteriorly directed bar from the anterior end. It measures 3.4×1.2 micra and seems to be somewhat pointed near the posterior end. M_3 measures $2.2 \times .9$ micra and is irregularly triangular in shape. It is located very near the cytostome.

Contractile Vacuole Pore. A single CVP is located near the posterior end and is associated with the end of the third ciliary meridian.

Cytoproct. The very short CYP is located very near the posterior end and is associated with the middle post-oral meridian.

Nuclear Components. Both a macronucleus and micronucleus are present and located either near the center or in the anterior end. The micronucleus is either near or embedded in the macronucleus which is spherical to ovoid in shape. The macronucleus measures 5.2 micra.

Paratetrahymena wassi is established as type-species of the new genus, by monotypy. Two silver impregnation preparations, one designated as containing the holotype and the other containing paratypes, have been deposited in the International Collection for ciliate Type-Specimens, a repository under the jurisdiction of the Museum of Natural History of the University of Illinois (see Corliss, 1963). Additional syntype slides remain in the collection of the author.

DISCUSSION

The family Tetrahymenidae Corliss (1952) the most recent family erected in the order Hymenostomatida, was established after the discovery of techniques which made possible a precise description of the simple tetrahymenal buccal apparatus found in such hymenostome ciliates. It should,



FIGURE 6



FIGURE 7

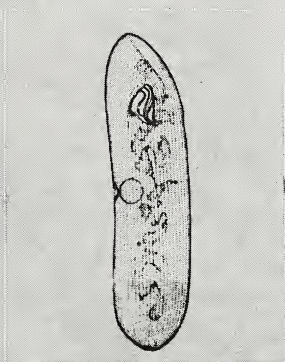


FIGURE 8

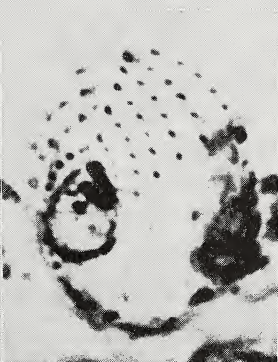


FIGURE 9

EXPLANATION OF FIGURES 6, 7, 8, 9.

Ventral views of silver impregnated animals. Fig. 6. *Sathrophilus*. Fig. 7. *Loxocephalus*. Fig. 8. *Deltopylum* (photograph of the drawing in the original paper). Fig. 9. *Cinetochilum*.

therefore, include no genus whose buccal structures are not fully known to agree with those characterizing the family. This presently does not seem to be the case. The buccal structures of only the genera *Tetrahymena*, *Colpidium*, *Deltopylum*, *Glaucoma*, *Loxocephalus*, and *Sathrophilus* are well enough described in the literature published to date to warrant definite assignment to this family. This means that the remaining genera *Dichilum*, *Monochilum*, *Stegochilum*, included in the family by Corliss (1961), and *Platynematum*, added by Borror (1962), cannot be assigned here at the present time, in the opinion of the writer.

Many workers have contributed to the understanding of the tetrahymenal buccal apparatus of several genera assigned to the family Tetrahymenidae. The most important workers and their papers include the following: *Tetrahymena* (Fig. 3), Furgason (1940), Kozloff (1946), Corliss (1953a); *Colpidium* (Fig. 4), Gelei and Horvath (1931), Furgason (1940), Corliss (1953a); *Glaucoma* (Fig. 5), Chatton and Brachon (1935), J. Gelei (1935), Furgason (1940), Corliss (1954); *Sathrophilus* (Fig. 6), Stout (1956), Thompson and Cone (1962); *Loxocephalus* (Fig. 7), J. Gelei (1940); and *Deltopylum* (Fig. 8), Faure-Fremiet and Mugard (1946).

The present author should like to present evidence to support the assignment of two additional genera, *Paratetrahymena* and *Cinetochilum*, to the family Tetrahymenidae. The present description of *Paratetrahymena wassi* shows a tetrahymenal buccal apparatus which is recognizably different from those described for other genera. A serious attempt was made by the author to make *Paratetrahymena* co-generic with one of the unassigned genera (see Corliss, 1961) in the order Hymenostomatida, but it was not possible to do so. The genus *Cinetochilum* (Fig. 9) was considered by Corliss (1961) to belong in a separate family Cinetochilidae Perty, 1852, but studies made by G. Gelei (1940), Klein (1942), and the present author (unpublished) show clearly a tetrahymenal buccal apparatus characteristic of the family Tetrahymenidae.

The genera of Schewiakoff (1889 and 1893), *Dichilum*, *Monochilum*, and *Stegochilum*, were not originally described as possessing membraneous buccal structures of a tetrahymenal nature. In view of the fact that proper techniques were not available in Schewiakoff's time we cannot be certain whether or not these three genera may be members of the family Tetrahymenidae. Only rediscovery and redescription will determine this. As presently described, therefore, it seems unwise to include them as members of this family.

The genus *Platynematum* was placed in the family Tetrahymenidae by Borror because "it possesses tetrahymenal buccal apparatus" (Borror, 1962, p. 345). Unfortunately no description or figures were published in sup-

port of this claim. Thus it seems that *Platynematum* should not be placed among the genera of this family until a full description has been published.

It is evident, as may be seen in careful examination of Figs. 1-9, that there are generic differences in the buccal infraciliature of the various genera of the family Tetrahymenidae. Although the infraciliature is similar (the family characteristic), careful study of the position, shape, and size of the buccal cavity and of the infraciliature of the undulating membrane and of the membranelles allows unique characterization of each genus within the family. Thus generic assignment can be made in the family Tetrahymenidae on the basis of the buccal infraciliature alone and, indeed, even more important, generic assignment cannot be made at all without a proper understanding of these essential taxonomic structures.

SUMMARY

The hymenostome holotrich family Tetrahymenidae is reviewed in light of modern techniques. It now includes only those genera which show the typical tetrahymenal buccal apparatus as described for this family. Four formerly assigned genera are omitted and two additional genera are included. A new genus and species, *Paratetrahymena wassi*, is described as a new member of this family.

LITERATURE CITED

- Borror, A. C. 1962. Ciliated Protozoa of the Gulf of Mexico. *Bull. of Marine Sci. of the Gulf and Caribbean* 12:333-349.
- Chatton, E. & S. Brachon. 1935. Discrimination, chez deux infusoires du genre *Glaucoma*, entre système argentophile et infraciliature. *C. R. Soc. Biol. Paris*, 118:399-403.
- Corliss, J. O. 1952. Characterization of the family Tetrahymenidae nov. fam. (Abstr.) *Proc. Soc. Protozool.* 3:4.
- Corliss, J. O. 1953a. Comparative studies on holotrichous ciliates in the *Colpidium-Glaucoma-Leucophrys-Tetrahymena* group. II. Morphology, life cycles, and systematic status of strains in pure culture. *Parasitology* 43:49-87.
- Corliss, J. O. 1953b. Silver impregnation of ciliated protozoa by the Chatton-Lwoff technic. *Stain Tech.* 28:97-100.
- Corliss, J. O. 1954. The buccal apparatus and systematic status of *Glaucoma frontata*. ("Dallsia frontata" Stokes). *J. Morph.* 94:199-220.
- Corliss, J. O. 1961. The Ciliated Protozoa: Characterization, Classifi-

cation, and Guide to the Literature. Pergamon Press, New York and Oxford.

- Corliss, J. O. 1963. Establishment of an International type-slide collection for the ciliate protozoa. *J. Protozool.* 10: (In press.)
- Faure-Fremiet, E., and H. Mugard. 1946. Sur un infusoire hofotriche histophage, *Deltopylum rhabdoides* n.g., n. sp. *Bull. Soc. zool. Fr.* 71: 161-164.
- Furgason, W. H. 1940. The significant cytostomal pattern of the "Glaucoma-Colpidium group," and a proposed new genus and species, *Tetrahymena geleii*. *Arch. Protistenk.* 94:224-266.
- Gelei, G. von. 1940. *Cinetochilum* und sein Neuronemensystem. *Arch. Protistenk.* 94:57-79.
- Gelei, J. von. 1935. Eine neue Abänderung der Klein'schen trockenen Silvermethode und das Silberliniensystem von *Glaucoma scintillans*. *Arch. Protistenk.* 84: 446-455.
- Gelei, J. von. 1940. Körperbau und Erregungsleitung bei den Ciliaten. Eine Studie an *Loxocephalus* und einigen anderen Ciliaten. *Arch. Protistenk.* 93:273-316.
- Gelei, J. von & P. Horvath. 1931. Eine nasse Silber-bzw. Goldmethode für die Herstellung der reizleitenden Elemente bei den Ciliaten. *Z. wiss. Mikr.* 48:9-29.
- Holz, G. G., Jr. and J. O. Corliss. 1956. *Tetrahymena setifera* n. sp., a member of the genus *Tetrahymena* with a caudal cilium. *J. Protozool.* 3:112-118.
- Kahl, A. 1930-1935. Urtiere oder Protozoa. I: Wimpertiere oder Ciliata (Infusoria), eine Bearbeitung der freilebenden und ectocommensalen Infusorien der Erde, unter Ausschluss der merinen Tintinidae. In Dahl, F., *Die Tierwelt Deutschlands*. Teil 18 (yr. 1930), 21 (1931), 25 (1932), 30 (1935), 1-886. G. Fischer, Jena.
- Klein, B. M. 1942. Differenzierungsstufen des Silberlinien-oder neroformativen Systems. *Arch. Protistenk.*, 96:1-30.
- Kozloff, E. N. 1946. The morphology and systematic position of a holotrichous ciliate parasitizing *Deroceras agreste*. *J. Morph.* 79:445-465.
- Schewiakoff, W. 1889. Beiträge zur Kenntniss der holotrichen Ciliaten. *Bibl. zool.*, 5:1-77.
- Schewiakoff, W. 1893. Ueber die geographische Verbreitung der

Suisswasser-Protozoen. Mem. Acad. imper. Sci. St. Petersb. (ser. 7), 41:1-201.

Stout, J. D. 1956. *Saprophilus muscorum* Kahl, a tetrahymenoid ciliate. *J. Protozoology*. 3:28-30.

Thompson, J. C., Jr., and V. Cone. 1962. A redescription of the hymenostome ciliate *Sathrophilus* (= *Saprophilus*) *muscorum* (Kahl, 1931) Corliss, 1960, with particular attention to the buccal apparatus. *Va. Jour. Sci.*, 14:16-22.

Quality



Products of The American Tobacco Company

"Tobacco IS OUR MIDDLE NAME"

**Representing
the
Most
Respected
Manufacturers
in the
Laboratory
Supply
Industry**

Corning Glass • Kimble Glass •
Coors Porcelain • Nalge Plastics
• Sheldon Furniture • Beckman
Instruments • Coleman Instru-
ments • American Optical Com-
pany • Bausch & Lomb, Inc. •
Eberbach Corporation • Inter-
national Equipment Company •
Burrell Corporation • Labora-
tory Equipment Company •
Ainsworth Balance • Ohaus
Balance • U.S. Stoneware •
J. T. Baker Chemicals • Mal-
linckrodt Chemicals • Matheson
Coleman & Bell Organics •
Precision Scientific Company •
Labline, Inc. • Thermolyne
Corporation • Buehler, Ltd. •
Baltimore Biological • Difco
Laboratories • Wm. Boekel &
Company • Humboldt Manufac-
turing Company • Hevi-Duty
Electric Company • W. A.
Taylor Company • Sartorius
Balance • Torsion Balance •
Hellige, Inc. • Plus Many
Others.

Serving the South for over 35 years

PHIPPS & BIRD, INC.



MANUFACTURERS AND DISTRIBUTORS OF SCIENTIFIC EQUIPMENT

6TH & BYRD STREETS — RICHMOND, VA.

PHONE MI 4-5401

BUSINESS MEMBERS
VIRGINIA ACADEMY OF SCIENCE

Albemarle Paper Manufacturing Company
Allied Chemical Corporation
The American Tobacco Company
Dan River Mills
The Dow Chemical Company
E. I. du Pont de Nemours and Company, Inc.
First and Merchants National Bank
General Electric Company
Larus and Brother Company, Inc.
The Newport News Shipbuilding Company Foundation
Norfolk and Western Railway Company
Philip Morris and Company, Limited, Inc.
Phipps and Bird, Inc.
Reynolds Metals Company
A. H. Robins Company
Southern Materials Company
State-Planters Bank of Commerce and Trusts
Virginia-Carolina Chemical Corporation
Virginia Chemicals and Smelting Company

THE ANNUAL SUBSCRIPTION RATE is \$3.00, and the cost of a single number, \$1.00. Reprints are available only if ordered when galley proof is returned. All orders except those involving exchanges should be addressed to Carl W. Allen, Virginia Polytechnic Institute, Blacksburg, Virginia. The University of Virginia Library has exclusive exchange arrangements, and communications relative to exchange should be addressed to The Librarian, Alderman Library, University of Virginia, Charlottesville, Virginia.

NOTICE TO CONTRIBUTORS

Contributions to the Journal should be addressed to Paul B. Siegel, Virginia Polytechnic Institute, Blacksburg, Virginia. If any preliminary notes have been published on the subject which is submitted a statement to that effect must accompany the manuscript.

Manuscripts must be submitted in triplicate, typewritten in double spacing on standard 8 1/2" x 11" paper, with at least a one inch margin on all sides. Manuscripts are limited to seven pages, with the proviso that if additional pages are desired, the author may obtain them at cost. The author may estimate the length of his paper by counting the total number of characters, including blank spaces, and dividing this by 3300. The result is the approximate number of printed pages in the Journal.

Division of the manuscript into subheadings must follow a consistent plan. It is desirable that a brief summary be included in all manuscripts.

Footnotes should be included in the body of the manuscript immediately following the reference, and set off by a dashedline above and below the footnote content. Footnotes should be numbered consecutively from the beginning to the end of the manuscript.

References should be arranged alphabetically according to author. Each reference should include the date, full title of the article, the name of the Journal, the volume and pages. For example: Harvie, L. E. and S. P. Maroney, Jr., 1961. Respiration and hemolysis of ultra-violet irradiated frog erythrocytes. *Va. Jour. Sci.* 12:1-9. References to the bibliographic citations should not be made by numbers. Instead, using the above citation, where a reference is desired: either (Harvie and Maroney, 1961) or Harvie and Maroney (1961).

Explanation of graphs and tabular material should be typed on separate pages. All figures should be numbered consecutively beginning with the first text figure and continuing through the plates. If figures are to be inserted in the text this should be indicated at the appropriate place in the margin.

Illustrations including lettering, should be arranged so that on reduction they will not exceed the dimensions of the maximum size of a printed page. Large plates must be accompanied by photographic copies which can be sent to the reviewers. The Journal will furnish the author with one plate or its equivalent; additional figures, colored illustrations or lithographs may be used only if the author makes a grant covering the cost of production. Original drawings (which must be done in black drawing ink) not photographs of drawings, should accompany the manuscript. When photographic prints are used they should be glossy, sharp and show good contrast. Drawings not neatly executed and labeled (do not use a typewriter), or which are not submitted on white paper will not be accepted.

Galley proofs are sent to the author for correction. Costs of excessive changes from the original manuscript must be defrayed by the author.

OFFICERS OF THE VIRGINIA ACADEMY OF SCIENCE

Jackson J. Taylor, *President*
Foley F. Smith, *President-Elect*
Paul M. Patterson, *Secretary*
Rodney C. Berry, Sr., *Treasurer*
William B. Wartman, *Assistant Secretary-Treasurer*

COUNCIL

P. A. Hansen	E. D. Brand	B. Harshbarger
H. G. M. Jopson	J. L. Calver	Suzie V. Floyd
G. T. Miller, Jr.	J. M. Grayson	E. F. Turner, Jr.
S. B. Row	S. B. Williams	H. Leidheiser, Jr.
P. B. Siegel	R. D. Hughes	W. W. Scott

~~586.73~~
~~V81~~
Q
1
V5X
NH

THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE

PROCEEDINGS FOR THE YEAR
1962-1963



Vol. 14, New Series

September, 1963

No. 4



VOL. 14, NEW SERIES

No. 4

SEPTEMBER, 1963

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND
SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

Printed by the *Bassett Printing Corporation*, Bassett, Virginia

CONTENTS

	<i>Pages</i>
Proceedings for the Year 1962-1963	
Detailed Table of Contents	140

EDITORIAL BOARD

Paul B. Siegel, *Editor*

Carl W. Allen, *Managing Editor*

SECTION EDITORS

W. P. Anslow, Jr.

C. Y. Kramer

N. F. Murphy

D. R. Carpenter, Jr.

W. H. Leftwich

W. T. Parrott

P. A. Hansen

A. Mandell

G. W. Thomas

M. A. Kise

J. C. Thompson

Entered as second-class matter, at the post-office at Bassett, Virginia under the Act of March 3, 1897. Subscription \$3.00 annually. Published four times a years January, April, July and September by the Virginia Academy of Science at Blacksburg, Virginia.

Mailed October 31, 1963

VIRGINIA ACADEMY OF SCIENCE



Proceedings for the Year
1962 – 1963

MINUTES OF THE FOURTH-FIRST ANNUAL MEETING

MAY 1-4, 1963

Hosts—Hollins College, Roanoke College
and Virginia Polytechnic Institute

Contents

OFFICERS, 1962-1963	141
MINUTES OF THE ACADEMY	
Council Meeting	142
Academy Conference	142
Academy Assembly	142
Council Meeting	142
Changes in the Constitution	143
REPORTS	
Resolutions	145
Treasurer	150
Finance	147
Investment Fund	152
Membership	153
History of Science	153
Scholarship	154
Journal	155
Virginia Flora	157
Research	158
Junior Academy	158
Science Talent Search	159
Place of Meeting	160
MINUTES AND ABSTRACTS OF SECTIONS	
Agricultural Science	160
Astronomy, Mathematics and Physics	180
Biology	196
Chemistry	215
Engineering	230
Geology	236
Medical Sciences	244
Microbiology	257
Psychology	260
Science Teachers	276
Statistics	278
LIST OF MEMBERS	285
LIST OF BUSINESS MEMBERS	319

Virginia Academy of Science

OFFICERS (1962-1963)

JACKSON J. TAYLOR, *President*

FOLEY F. SMITH, *President-Elect*

PAUL M. PATTERSON, *Secretary*

RODNEY C. BERRY, *Treasurer*

WILLIAM B. WARTMAN, JR., *Assistant Secretary-Treasurer*

COUNCIL (1962-1963)

Elected and Section Representatives

P. A. HANSEN

E. D. BRAND

S. B. WILLIAMS

H. G. M. JOPSON

J. L. CARVER

MISS S. V. FLOYD

G. T. MILLER, JR.

B. HARSHBARGER

J. M. GRAYSON

S. B. ROW

E. F. TURNER, JR.

Past-Presidents

W. M. HINTON

W. B. BELL

H. H. HOBBS, JR.

Ex-Officio

H. LEIDHEISER, JR.

P. B. SIEGEL

R. D. HUGHES

W. W. SCOTT

Trustees

L. C. BIRD

C. T. O'NEILL

H. R. HANMER

ABSTRACTS OF MINUTES

COUNCIL MEETING, *Hotel Roanoke, May 2*

Present were 15 Council Members and several Committee Chairmen. In accordance with the directive of Council at their meeting on April 21, the Secretary shall keep on file complete minutes of meetings and submit an abstract of the same for publication.

The reports to be given at the Academy Conference were reviewed, discussed and approved.

An invitation from President Webb of Old Dominion College to meet in Norfolk in 1967 was approved. Adjournment.

ACADEMY CONFERENCE, *Hotel Roanoke, May 2*

The meeting was called to order at 8:15 by President Jackson Taylor.

The principle business was as follows: (1) constitutional changes approved, (2) committee reports approved, and (3) place of meeting for 1966 in Harrisonburg and Norfolk in 1967 approved. The first two items are published separately in this issue.

ACADEMY ASSEMBLY, *Hotel Roanoke, May 3*

After a welcome by President Hahn of VPI and greetings from the AAAS by Dr. Raymond Taylor, Mrs. Black read the resolutions which were adopted. The Horsley Award was given to Dr. H. A. David for his paper entitled *The Method of Paired Comparisons* and the Meritorious Service awards were bestowed upon Drs. Jesse W. Beams, Allen Gwathmey and Sidney Negus. The VJAS and Talent Search awards were announced and the officers and new councilmen were presented by the nominating committee and accepted as follows: *President*, Foley Smith; *President-Elect*, S. S. Obenshain; *Secretary*, Russell J. Rowlette, Jr.; *Treasurer*, William B. Wartman, Jr.; *Council*, W. M. Wolcott, W. E. Trout, J. E. Echel and P. Arne Hansen. Academy speaker was Dr. John Sauer of Pennsylvania State University whose topic was *The Molecular Motion in Solids*.

Paul M. Patterson, *Secretary*

CHANGES IN THE CONSTITUTION OF VIRGINIA ACADEMY OF SCIENCE

ARTICLE 4: *Election of Members*

Members of all classes except honorary life must be accredited by the Secretary, or the Treasurer, of the Council of the Academy. See Article 3, Section 5, concerning honorary life membership.

ARTICLE 5: *Officers*

The officers of this organization shall consist of a President, a President-elect, a Secretary and a Treasurer.

ARTICLE 6: *Council*

The executive body of this organization shall be known as the Council. It shall be composed of the President, the President-elect, the Secretary, the Treasurer, the three most recent Past Presidents, and one member elected by each Section of the Academy. The members from the several Sections shall be elected for three year terms, on a rotational basis among Sections. In addition to the above listed members the following shall be ex-officio members of the Council: (1) the Editor of the Journal, (2) the Chairman of the Long Range Planning Committee, (3) the Chairman of the Research Committee, (4) the Chairman of the Committee for the Junior Academy of Science, (5) the Chairman of the Board of Trustees, (6) the Chairman of the Membership Committee, and (7) the Chairman of the Finance and Endowment Committee. In case of death or other unforeseen interruption of this routine, the President shall make interim appointments until the next election is held.

ARTICLE 7: *Duties of the Council*

1. The Council shall have charge of the policy of this organization and its funds.

2. The Council shall supervise the publication of the Academy Journal, including the appointment of the Editor, Associate Editor, Managing Editor, and Advertising Manager. The term of office of each shall be set by the Council.

3. The Council may establish the office of Executive Secretary-Treasurer, and employ such personnel as may be required. The term of office, the duties of the office, and the remuneration shall be prescribed by the Council.

ARTICLE 8: *Election of Officers and Council Members*

A Nominating Committee, appointed by the President, usually consisting of the three immediate Past Presidents, shall submit to the annual meeting nominations for President-elect, Secretary, Treasurer, and for one or more members of the Council. Nominations from the floor shall be in order. These officers shall be elected annually by the membership. The President and President-elect may not succeed themselves.

CHANGES IN BY-LAWS OF VIRGINIA ACADEMY OF SCIENCE

SECTION 2: *Duties of Officers*

(3) The Secretary shall be responsible for the following:

- A. Keeping a complete record of each annual meeting and of other meetings held during the year by Council.
- B. Preparing a report of the proceedings of these meetings for publication.

(4) The Treasurer shall be responsible for the following:

- A. Keeping the membership lists of the Academy in up-to-date fashion.
- B. Supplying the Secretary and Managing-Editor of the JOURNAL with the names of all new members and on January 1 of each year with the list of all members whose dues are paid by that date.
- C. Receiving and disbursing all funds, except as provided under Section 5, (2), as directed by the Council and approved by the President or Chairman of the Finance Committee.
- D. Submitting at the annual meeting a written report of all receipts and disbursements. His annual report shall be accompanied by an audit by a recognized public accountant.
- E. Furnishing quarterly financial summaries to the officers, to members of the Council, and to members of the Finance Committee.
- F. Reporting annually a budget for Academy operation to be presented to the Finance Committee for review.

The Treasurer shall be adequately bonded.

(5) Officers shall serve ex-officio on all committees of the Academy.

SECTION 3: *Remuneration of Elected Officers*

The elected officers shall serve without remuneration.

SECTION 4: *Official Representation of the Academy*

Where official representation of the Academy is desirable, the President shall designate such Academy representatives. No officer or other Academy member shall receive reimbursement from Academy funds for such purposes, except for attendance at the annual meeting of the American Association for the Advancement of Science. This is to ensure that the Academy will have a continuity of representation on the Council of the American Association for the Advancement of Science. The representative's reimbursement shall not exceed round-trip railroad fare, plus a maximum of \$15.00 per day expenses.

SECTION 6: *Committees*

- (1) The President, the President-Elect, the Secretary, and the Treasurer shall comprise the Executive Committee of the Council.
- (2) The research Committee shall be composed of five members, each appointed for a term of five years. One new member shall be appointed each year by the President to replace the member whose term will expire. The senior member of the Committee shall serve as Chairman.
- (3) The Council shall have the right to establish other appropriate standing Committees, and such special Committees as, and when, needed.

REPORT OF THE RESOLUTIONS COMMITTEE

Inasmuch as, the members of the Virginia Academy of Science have assembled for their Forty-First Annual Meetings in the City of Roanoke, Virginia, from May 1 until May 4, 1963,

And inasmuch as, these Meetings are now drawing to a close, Therefore, it is deemed fitting that certain resolutions, expressive of the sentiment of the members, be entered upon the minutes;

Namely, that,

Whereas, all of the officers, section chairmen, and committee chairmen have performed their duties faithfully and well, Be it resolved: that

we thank them for giving their time and loyal concern to the work of the Academy.

And whereas, a Past President, Dr. Paul M. Patterson, is leaving the office as Secretary at his own request, at the end of his term this year,

Be it resolved: that we express to him our deep sense of obligation and affection.

And whereas, our hosts, Hollins College, Roanoke College, and Virginia Polytechnic Institute, and Mr. Jack Smith, Exec. Vice-President of the Roanoke Chamber of Commerce, and also the chairman of the Committee on Arrangements, Dr. Boyd Harshbarger, together with the members of his committee, have received us with gracious hospitality, and have made excellent plans for our convenience and for the success of these meetings,

Be it resolved: that we convey to them our sincere appreciation for their concerned efforts on our behalf.

And whereas the management and staff of our headquarters hotel, the Hotel Roanoke, have treated us kindly, and have given courteous and efficient service,

Be it resolved: that we convey to them our appreciation.

And whereas, the commercial exhibits arranged for these meetings have attracted much interest,

Be it resolved: that we express to the commercial companies represented our thanks for their cooperation and for the excellence of their displays.

And whereas, the roll of members has been decreased by several deaths,

Be it resolved: that we note these deaths with sadness;
Russell Miller, Louis A. Pardue, William W. Cash, Jr.,
Gilbert Rich, Charles Nelson, John Meredith,
Frederick Vultee, W. Meade Addison, Ida Sitler,

Alfred Ackerman, J. Peachy Harrison, and John W. Watson

Zoe W. C. Black, *Chairman*

REPORT OF THE FINANCE COMMITTEE

STATEMENT OF DISBURSEMENTS PERIOD ENDING 31 DECEMBER 1962

	Approved Budget 1962	Disbursed 1962	Proposed Expenditures 1963
Sect'y & Treas.			\$1,200.00
Honorarium Executive			
Clerical Assistance for Sect'y ..			600.00
AAAS Travel Expenses	350.00	210.04	400.00
Academy Conference Dues	20.00	20.00	20.00
W. Catesby Jones Award	10.00	10.00	10.00
E. C. L. Miller Award	50.00	50.00	50.00
Junior Academy Activities (Incl. Philip-Morris & American Tobacco grants	2,000.00	2,560.78	1,300.00
Science Talent Search	700.00	626.15	700.00
Annual Meeting Expenses	475.00	584.16	700.00
Treasurer's Bond Premium	12.50	12.50	25.00
P. O. Box Rent	32.00	32.00	32.00
Stationery and Supplies	125.00	74.25	125.00
Postage, Section Expense Printing, Addressograph Service	700.00	926.26	1,000.00
Virginia Journal of Science	2,100.00	2,450.00	2,100.00
Miscellaneous	150.00	118.53	250.00
Corporation Charter Fee	5.00	5.00	5.00
Annual Meeting Program	500.00		500.00
Publication of Academy History			1,800.00
Audit—Tax Service	475.00	465.00	500.00
	\$7,704.50	\$8,144.67	\$11,317.00
Cash on Hand 1 January, 1962			\$ 5,317.00
Expenditures over Approved Budget 1962			440.77

Boyd Harshbarger, Chairman

CONSOLIDATED FUND BALANCE SHEET**December 31, 1962**

(Prepared on Cash Basis of Accounting)

ASSETS**GENERAL FUND:**

Cash in bank (Exhibit B)	\$ 5,880.66
Investments—at cost	
(Market value \$2,275.00)	2,445.95
Due from Special Trust Fund	3,000.00
Due from Virginia Institute for Scientific Research Building Fund	611.00

Total General Fund	\$11,937.61
---------------------------------	--------------------

RESEARCO FUND:

Cash in bank (Exhibit C)	\$ 1,141.54
--------------------------------	-------------

Total Research Fund	2,241.54
----------------------------------	-----------------

TRUST FUND PRINCIPAL:

Cash on deposit (Exhibit D)	\$ 399.15
Investments—at cost:	
U.S. Treasury Notes	
U. S. Treasury Notes (Market value \$3,004.20)	\$ 2,928.75
Commercial Bonds (Market value \$4,735.50)	4,982.10
Stocks (Market value \$25,790.51)	14,374.70
Savings account (with interest \$150.38)	150.00
	<u>22,435.55</u>

Total Trust Fund Principal	\$22,834.70
---	--------------------

TRUST FUND INCOME:

Cash on deposit (Exhibit E)	694.65
-----------------------------------	--------

SPECIAL TRUST FUND PRINCIPAL:

Cash on deposit (Exhibit F)	\$ 214.14
Investments—at cost:	
U.S. Treasury Notes (Market value \$5,115.00)	\$ 5,021.88
Stocks (Market value \$1,280.00)	1,752.50
	<u>6,774.38</u>

SPECIAL TRUST FUND INCOME:

Cash on deposit (Exhibit G)	142.75
-----------------------------------	--------

<u><u>\$44,839.77</u></u>

EXHIBIT A

LIABILITIES AND FUND BALANCES

GENERAL FUND:

Advance payment of dues	\$ 257.00	
James River Basin Fund	416.10	
Fund balance	<u>11,264.51</u>	
Total General Fund		\$11,937.61

RESEARCH FUND:

Fund balance	<u>\$ 2,241.54</u>	
Total Research Fund		2,241.54

TRUST FUND PRINCIPAL:

Fund balance	<u>\$22,834.70</u>	
Total Trust Fund Principal		22,834.70

TRUST FUND INCOME

Fund balance		694.65
--------------------	--	--------

SPECIAL TRUST FUND PRINCIPAL:

Due to Research Fund	\$ 1,100.00	
Due to James River Project	1,600.00	
Due to General Fund	3,000.00	
Increment from sale of securities	<u>1,288.52</u>	
Total Special Trust Fund Principal		6,988.52

SPECIAL TRUST FUND INCOME:

Fund balance		142.75
		<u>\$44,839.77</u>

J. WADDELL RISON & COMPANY*Certified Public Accountants*

Richmond 19, Virginia

April 18, 1963

The Officers and Council Members

Virginia Academy of Science

Richmond, Virginia

Gentlemen:

We have examined the recorded cash receipts and disbursements of the Virginia Academy of Science, Richmond, Virginia, for the year ended December 31, 1962, and submit herewith our report thereon, consisting of the statements listed in the foregoing index. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

The amounts shown on the Consolidated Fund Balance Sheet, Exhibit A, and Statements of Cash Receipts and Disbursements, Exhibits D. E. F. and G, relating to Trust Agency Fund Accounts, were taken from the December 31, 1962 report of the Trust Agent, First and Merchants National Bank of Richmond, and were not verified in any manner.

In our opinion, the accompanying statements prepared on a cash basis of accounting, present fairly the financial position of the Virginia Academy of Science at December 31, 1962, and the recorded cash transactions for the year then ended, on a basis consistent with that of the preceding year.

Respectfully submitted,

J. WADDELL RISON & COMPANY

By: J. Waddell Rison

Certified Public Accountant

JWR:eg

15/2

REPORT OF THE TREASURER**GENERAL FUND****CASH RECEIPTS AND DISBURSEMENTS STATEMENT
FOR THE YEAR ENDED DECEMBER 31, 1962**

Exhibit B

REVENUE RECEIPTS:**Dues:**

Business members	\$ 1,900.00
Sustaining members	560.00

Contributing members	790.00	
Regular members	2,068.00	
Student members	42.00	
Delinquent dues	173.00	
Dues Applicable to Current Year	\$ 5,533.00	
Deduct—above dues collected prior year	274.00	
Dues Collected in Current Year		\$ 5,259.00
Gifts, grants and bequests:		
General	\$ 1,110.00	
For Virginia Institute Scientific Research Building	189.00	1,299.00
Income from Special Trust Agency Fund (Exhibit G)		285.50
Dividends received on corporate stock investments		105.40
Total Cash Revenue Receipts		\$ 6,948.90
NON-REVENUE RECEIPTS:		
Advance payment of dues	\$ 257.00	
Sale of James River Basin books	21.00	
Annual meeting receipts:		
Registration fees	\$ 703.60	
Exhibit space fees		
(Net of \$75 refund)	1,520.00	
Total Cash Non-Revenue Receipts	2,223.60	
Total Cash Receipts		2,501.60
Total Cash Receipts		(1) \$ 9,450.50
DISBURSEMENTS:		
Annual meeting expense		
(Net after \$51.92 refund)	\$ 878.24	
American Association for the Advancement of Science Meeting	210.04	
Virginia Junior Academy of Science	2,560.78	
Postage and express	308.12	
Printing expense	253.92	
Stationery, supplies and stenographic service	74.25	
Virginia Journal of Science	2,450.00	
Science talent search	626.15	
E. C. L. Miller Award	50.00	
W. Catesby Jones Award	10.00	
Miscellaneous and general expenses (Schedule B-1)	703.03	
Cash transfer to trust fund principal (Exhibit D)	2,500.00	
Total Cash Disbursements		(2) \$10,624.53
Excess Disbursements over Receipts		
(1) minus (2)		\$ (1,174.03)
ADD—Balance, January 1, 1962		7,054.69
BALANCE ON DEPOSIT—DECEMBER 31, 1962		
(Exhibit A)		\$ 5,880.66

REPORT OF THE INVESTMENT FUND TRUSTEES

GENERAL ENDOWMENT ACCOUNT

	Book Value	Market Value
Amount invested in Bonds		
Government and Corporate	\$ 7,910.85	\$ 7,770.00
Amount invested in Preferred		
Stocks	1,790.85	1,470.00
Amount invested in Common Stock	12,583.85	23,843.00
Miscellaneous (Savings Account)	150.00	150.00
	<hr/>	<hr/>
	\$22,435.55	\$33,233.00
Cash Principal	399.15	399.15
	<hr/>	<hr/>
Total	\$22,834.70	\$33,632.15
Estimated Annual Income	\$1,366.00	
Cash Income Balance	156.39	

SPECIAL ACCOUNT

Amount invested in Bonds—		
Government	\$ 5,021.88	\$ 5,100.00
Amount in Common Stock	1,752.50	1,360.00
	<hr/>	<hr/>
	\$ 6,774.38	\$ 6,460.00
Cash Principal	214.14	214.14
	<hr/>	<hr/>
Total	\$ 6,988.52	\$ 6,674.14
Estimated Annual Income	\$286.00	
Cash Income Balance	12.00	
Total book value of investments as of 3/20/63	\$29,823.22	
Total market value of investments as of 3/20/63		\$40,306.29

Lloyd C. Bird, *Chairman*

REPORT OF THE MEMBERSHIP COMMITTEE

Subcommittee for Individual Members:

Individual invitations to joint the Academy mailed to	123
Resulting applications for membership	18
Additional applications for membership	2
Total applications for membership	20
Total membership in all classes	1114

Additional activity: Canvass of the membership to determine correct addresses, current affiliations and interest in Academy committee work.

Lawrence R. Quarles, *Chairman*

Subcommittee for Business Members:

During the year, all business members have been contacted and a letter report made to them on the activities of the Academy for 1962. This was specifically slanted to bring out the highlights which would be of interest to our business members. Attention was called to the annual meeting held in Norfolk last May where the outstanding symposium on Virginia's Natural Resources was presented. Also, the excellent program of the Junior Academy and its role in the future of the state's scientific community was mentioned.

A list of the companies now participating as business members are given in each issue of the *Virginia Journal of Science*.

William P. Boyer, *Vice-Chairman*

REPORT OF THE HISTORY OF SCIENCE
IN VIRGINIA COMMITTEE*The History of the Virginia Academy*

All material from Dr. George W. Jeffers is to be turned over to the editor, Dr. Russell J. Rowlett, Jr., at this meeting. After the History is put into proper form for publication, it will appear as an extra number of the *Virginia Journal of Science*. It will then be distributed free to the Academy general mailing list. The cost of the publication is not a part of the regular appropriation for the Journal.

The History Committee requests than any members who have photographs of Academy groups suitable for inclusion in the History will lend

them to the Committee for possible inclusion of their copies in the publication. If possible, please attach an identification diagram to your photograph. The material loaned will be treated with care, and will be returned to the owner.

Also, any one who attended the 1925 meeting in Richmond, can be of inestimable help if he will aid in identifying the members of the group seated on the steps of the Baptist Church. A copy of the picture, in the 1925 *Proceedings*, is available with identification diagrams, and I shall have them on hand throughout today and Friday. Please contact me.

The Archives

The Virginia Institute for Scientific Research is housing the Archives in its Library. The Archives consist of:

1. A complete file of *Proceedings and Journals* 1923-1924-1961-1962, and a complete file of *Claytonia*. These are bound.
2. A filing cabinet in which will be placed other memorabilia: Dr. Ivey F. Lewis has turned over to the Archives invaluable correspondence relative to the founding of the Academy. This material dates from 1920 through his presidency. Senator Lloyd Bird has given a similar contribution from the Long Range Planning Committee from 1940-1949. The History Committee hopes that many of those who have guided the Academy will make similar donations to the Archives.
3. Dr. Miller's card index of the early membership, with his records.

The Virginia Institute for Scientific Research has generously offered to assume the *care* and the *cost* of the binding, cataloging, and filing of future volumes of the *Journal*. The file of the Archives in the VISR Library will be kept up to date.

Isabel Boggs, *Chairman*

REPORT OF THE SCHOLARSHIP COMMITTEE

The Scholarship Committee of the Academy worked during the past year primarily with high school teachers who are doing a splendid job in securing scholarships for their students with potential possibilities of careers in science. All teachers of science in the high schools of Virginia have been informed of the literature available concerning scholarships, loan funds, fellowships, and assistantships not only in the colleges in Virginia but throughout the nation.

Members of the committee individually have endeavored to secure

college scholarships for 26 high school students in Virginia and 4 outside the State. With the backing of the Virginia Academy of Science, the efforts of the committee have been successful in most cases. Most of the success of the committee, however, has been in working indirectly with high school teachers.

Sidney S. Negus, *Chairman*

REPORT OF THE AUDIT OF THE VIRGINIA JOURNAL OF SCIENCE

Gentlemen:

I have examined the records of the Virginia Journal of Science, for the year ended December 31, 1962, and submit herewith my report together with my recommendations.

In my opinion, the accompanying statements present fairly the financial position of the Virginia Journal of Science at December 31, 1962, and the results for the year then ended in conformity with generally accepted accounting principles.

FINANCIAL STATEMENT

VIRGINIA JOURNAL OF SCIENCE

For the Year Ended December 31, 1962

RECEIPTS:

Academy Subsidy	
members	\$2,000.00
proceedings	450.00
Advertising	549.20
Subscription	365.50
Extra pages (July issue)	505.00
Back issues	58.00
	<hr/>
Total Receipts	\$3,927.70

EXPENDITURES:

Printing	\$4,915.50
Envelopes	165.85
Stationery	28.24
Postage	11.37
	<hr/>
Total Expenditures	\$5,120.96

STATEMENT OF CASH ACCOUNT:

Balance January 1, 1962	\$3,278.29
Receipts for Year	3,927.70
	<hr/>
January 1 Balance and Receipts	\$7,205.99
Expenditures for Year	5,120.96
	<hr/>
Balance December 31, 1962	\$2,085.03
	<hr/>

Audited by Frank Bulter.

REPORT OF THE COMMITTEE ON VIRGINIA FLORA

Members of the committee have been busy with academic matters, leading local meetings, working over specimens on hand and field activities. Dr. Patterson continues the study of the Bryophytes giving special attention to a collection of Dr. A. R. Shields from Beartown Mountain in Russell Co. Dr. Crandall and Dr. Chamberlain, cooperating, continue their ecological investigation of certain Piedmont Forests. Miss Artz has been active meeting groups, presenting talks of wildflowers and conservation. She devotes her attention to the flora of the Massanutten Mountains, and has been especially interested in the occurrence and protection of the black ash, *Fraxinus nigra*. The Forest Service has assured her that steps will be taken to protect the ash and other rare plants of the Massanutten.

Dr. A. R. Shields, formerly a member of the committee, was awarded the Ph. D. degree by the University of Tennessee last June. He is now a member of the staff of Maryville College, Tennessee. His dissertation is devoted to an ecological investigation of Mt. Rogers, with less emphasis on White Top Mountain and Beartown Mountain. It is a valuable contribution to the Flora and Ecology of major mountains of southwestern Virginia. It is hoped that he will have it published.

Dr. Warren Wagner, Jr., of the University of Michigan conducted a Pteridology during the 2nd summer term in the Mountain Lake Biology Station. In the course of their field work they record several species which had not been reported in Giles and other southwestern Virginia counties. Dr. Wagner has presented an important manuscript giving the results of the terms field work in the investigation of the Pteridophytes of Giles Co., and some outlying areas. Several species and hybrids new to Giles Co. and some new to Virginia are reported. Also included in the manuscript are discussions relative to phases of the biology of ferns. Being a long standing policy of the Flora Committee to promote publications relative to the flora of Virginia, a contribution of \$75 to help the publication has been promised. The appearance in botanical literature of a paper of this type is a compliment to the Mountain Lake Biological Station.

It is not of local interest only as new data relative to Pteridology is included.

When visiting the V. P. I. Herbarium Dr. Wagner pointed out that we have a specimen of *Botrychium alabamense* from Wise Co. The species had not been recorded north of North Carolina. Thus a species new to Virginia flora and Gray's Manual range, is recorded and its northward range extension of some 150 miles. A publication is to appear in the American Fern Journal.

In closing we express our sincere regret of the passing of Dr. H. A. Allard. He contributed several papers relative to the flora of Virginia, some of which Mr. E. C. Leonard cooperated.

A. B. Massey, *Chairman*

REPORT OF THE RESEARCH COMMITTEE

Nine papers were submitted to the Research Committee in competition for the 1963 Horsley Award. The fields of biology, chemistry, physiology, and statistics were represented. While the quality of papers submitted was excellent, several active fields of research in Virginia were not represented. This means that there is insufficient incentive for entering the Horsely Award competition, or there is generally a lack of understanding of the important role that the Award plays, or should play, in strengthening the Academy's effort in promoting science in our Commonwealth.

The Research Committee, at its April 23, 1963 meeting, passed a unanimous resolution recommending that the Council increase the Horsely Award from \$100 to \$500 beginning in 1964. The Committee felt that this would be one of the best possible ways to utilize the monies at its disposal, and the best way to stimulate papers in competition.

Grants-in-aid were awarded as follows:

Dr. L. R. Emmons, Washington and Lee College—\$585

Dr. Marie Jenkins, Madison College—\$360

Dr. Lee S. Anthony, Roanoke College—\$400

The other expenditure was the Horsley Award (\$100).

R. D. Hughes, *Chairman*

REPORT OF THE JUNIOR ACADEMY OF SCIENCE COMMITTEE

As chairman of the VJAS Committee, it is my pleasure to report to the membership of Virginia Academy of Science a summary of our activities during the past year.

As most of you realize, these meetings mark the climax of our 22nd year as a state Junior Academy. We feel that this year has been a most successful one. Our membership now includes 68 permanently affiliated science clubs with a total membership of approximately 2,000 students and teacher-sponsors. Our efforts during the past two years to direct our pro-

gram toward the more outstanding high school science students seems to have been justified by the abundance of excellent papers presented today. Approximately 125 papers were read in 10 concurrent sessions this morning and afternoon. These papers were selected from more than 200 abstracts submitted.

Awards totaling more than \$900.00 will be made at the Annual Awards Hour to be held at 9:30 a.m. tomorrow morning in the Shenandoah Room. We cordially invite the members of the Senior Academy to be present at this time. These awards were made possible by a generous grant from the Philip Morris Co., Inc.

The Junior Science Bulletin, financed by a grant from the American Tobacco Co. Research Laboratory, was published and distributed to Virginia high schools. This bulletin is prepared by the VJAS junior officers and edited by Mr. A. B. Niemeyer of Churchland High School. The VJAS has also prepared and distributed a new brochure entitled the "VJAS Booklet." This publication was prepared through the efforts of Mr. Marc Salzberg, a student at Norfolk Academy.

Three former VJAS members, Miss Joyce Howell (past president of the VJAS) of Stewartsville High School, Miss June Loguirato of Fairfax High School, and Mr. Robert Williams of William Flemming High School, Roanoke, presented science papers at the first meeting of the National Junior Academy held in conjunction with the recent AAAS meetings in Philadelphia, Dec. 26-30, 1962.

Thirteen VJAS students and three teacher-sponsors will leave next week for Albuquerque, New Mexico to participate in the first National Science Seminars. They will represent Virginia through an invitation from the New Mexico Academy of Science for a period of six days.

The VJAS committee held three meetings during the past year with well over 90% in attendance. I would like to take this opportunity to thank the VJAS Committee, the Council of the VAS, and the VAS membership for the splendid cooperation received during the past year.

William W. Scott, *Chairman*

REPORT OF SCIENCE TALENT SEARCH COMMITTEE

The Colleges and Universities in the State of Virginia were contacted and asked to indicate the number of scholarships they would offer the Winners and Honorable Mentions of this year's Science Talent Search. Twenty schools responded and over \$30,000 in scholarship aid was listed as available to outstanding high school students.

A total of 751 sets of examinations were requested by teachers, in 73

high schools, from Science Clubs of America. Completed forms from 122 students of 36 schools were sent to me from Science Clubs of America. With the aid of a reading committee, 45 of the best reports were selected. These 45 students were invited to the annual meeting of the Virginia Academy of Science, held this year in Hotel Roanoke, Roanoke, Virginia.

Thirty-eight students were present for the interviews. Listings of available scholarships, readers, interviewers and students are available.

E. V. Russel, Jr., *Director*

REPORT OF THE COMMITTEE ON PLACE OF MEETING

The Committee, after careful consideration of the question of where to meet in May 1966, decided to recommend the acceptance of the invitation extended by Dr. G. Tyler Miller, President of Madison College, to meet at Madison College.

President Miller in his invitation stated that Madison College will have new additions to the present science building completed in 1964 which will very adequately meet the needs of the Virginia Academy for display rooms and meeting rooms. President Miller further stated that there are now three large motels in the Harrisonburg community which will meet all expected housing needs.

Submitted by John C. Wells
for Col. S. M. Helflin,
Committee Chairman

SECTION OF AGRICULTURAL SCIENCE

Lawrence I. Miller, *Chairman*

T. Graham Copeland, Jr.,
Vice-Chairman

Edward A. Borchers, *Secretary*

Grant W. Thomas, *Section Editor*

MINUTES

The forty-first annual meeting of the Virginia Academy of Science was held at the Hotel Roanoke in Roanoke, Virginia on May 1-4, 1963. The Agricultural Science Section met at 8:30 A.M. on Friday, May 3 in Parlor F. Chairman L. I. Miller appointed a nominating committee consisting of R. W. Young, D. L. Hallock and R. N. Hofmaster, and presided over the morning session.

After the afternoon session, directed by Secretary E. A. Borchers, Dr.

Miller called the business meeting. The nominating committee recommended the following for officers of the Agricultural Science Section for 1963-1964: T. Graham Copeland, *Chairman*; Edward A. Borchers, *Vice-Chairman*; and John H. Wilson, Jr., *Secretary*. These men were elected as officers for the year 1963-1964.

The Saturday morning session was also held in Parlor F. and was presided over by Vice-Chairman T. Graham Copeland, Jr.

Edward A. Borchers, *Secretary*

THE USE OF PLANT RESISTANCE IN CONTROLLING INSECT PESTS OF PEANUTS IN VIRGINIA

W. M. Alexander and G. M. Boush

Virginia Agricultural Experiment Station, Holland

3. A Strain of southern corn rootworm *Diabrotica undecimpunctata howardi* resistant to aldrin and heptachlor was observed in the Cypress Chapel area of Nansemond County, Virginia in 1958. The frequency of the development of resistance to insecticides by insects prompted the investigation of alternate methods of control.

In 1958 and 1959 about 100 peanut lines were evaluated for resistance to rootworm. Differential reaction to rootworm was noted but degree of resistance was low. Approximately 2,350 plant introduction lines and advanced breeding lines were evaluated for resistance to rootworm between 1960 and 1962. Plants were evaluated visually in 1960 and a re-evaluation of lines classified as resistant showed a range of reaction to rootworm with the majority less susceptible than the check variety Va. 56R. Actual counts of damaged fruits and damage percentages were calculated in 1961 and 1962. Lines with less than 5% injury in any replication, as compared with 33% injury in check, were carried into the 1962 evaluation experiments. All lines re-evaluated had a lower infestation than the check variety Va. 56R. In 1962, one line had approximately 6% injury as compared to 38% for the check variety in two evaluation experiments.

The 2,350 peanut lines were evaluated for possible thrips resistance. A range of reaction to thrips was observed, however, the level of resistance was not as high as that observed with rootworm.

NEW CONCEPTS IN THE EMPLOYMENT OF SOIL INSECTICIDES

G. M. Boush and M. W. Alexander,

Virginia Agricultural Experiment Station, Holland

4. During recent years, it has become increasingly apparent that numerous soil insect pests have developed resistance to previously recommended and effective chlorinated hydrocarbon insecticides. A partial list of soil pests which are no longer controlled by these chemicals includes wireworms on tobacco and potatoes; rootworms attacking corn and peanuts; flea beetle larvae attacking potatoes; and four species of *Hylemya* (root maggots) attacking corn and cole crops.

The development of new soil insecticides effective against these cyclo-diene-resistant pests, has altered several previously accepted methods involving application, formulation, and post-application methods. With the C-H group, residual activity was long (at least full-season), thus allowing for application of the pesticide considerably in advance of the specific time needed. Because of persistence, residues occurred. In addition, formulation had little effect on control; dusts, sprays, and granules worked equally well.

Newly developed insecticides effective against C-H resistant soil pests belong to either the organic phosphate or carbonate group. With these compounds, residual activity is relatively short, usually less than 60 days, and they are effective only in granular form. To afford control they must be dove-tailed with the life cycle of the pest involved. However, if timed correctly, residue problems often can be eliminated.

CROSS RESISTANCE TO INSECTICIDES IN THE GERMAN COCKROACH

Donald G. Cochran,

Virginia Agricultural Experiment Station, Blacksburg

6. The development of insect resistance to insecticides has become a serious world-wide problem. There are published reports on about 140 species of medically and agriculturally important insects and other arthropods which show resistance to insecticides. Complicating the picture further is the observation that a given species may show resistance not only to the toxicant with which it has been selected, but also to other insecticides that it has not previously encountered. This phenomenon is referred to as cross resistance. In the present report, studies with resis-

tant strains of the German cockroach, *Blattella germanica* (L.), have been used to illustrate the known types of cross resistance.

With some strains cross resistance is quite simple, being limited only to insecticides which are closely related structurally. For example, the chlordane resistant strain of cockroaches also show resistance to dieldrin, aldrin, and lindane. Other strains show resistance to unrelated compounds. In the example of the cockroach strain resistance to DDT and chlordane, the explanation is probably the consecutive exposure to both toxicants. The strain which is resistant to DDT and to Sevin following selection only with DDT is an anomalous case which is more difficult to explain. The results of this work are interpreted in light of the evidence currently available.

EXTRACTION OF REDUCED CYTOCHROMES 552 and 556 FROM EUGLENA

G. Colmano, *Virginia Agricultural Experiment Station, Blacksburg*

23. Cytochromes 552 and 556, *extracted and isolated from Euglenas in the oxidized form and then chemically reduced*, have been described by Nashimura in Japan and in the U.S. by Gross and Wolken and by Perini, Kamen, Schiff and Epstein in Kamen's laboratory. Cytochrome-552 seems to be intimately associated with the photosynthetic apparatus and so far it has been isolated only from green, light-grown, actively photosynthesizing cells, in an approximate ratio of one molecule for 300-600 chlorophyll molecules. Cytochrome-556, believed to be a mitochondrial component, has been described in light-grown cells in a ratio of one molecule for 5-6 cytochrome-552 molecules.

The solubility of cytochromes, as compared to the relative insolubility of other pigments, in water, was exploited as a selective extraction and purification principle (Colmano and Wolken, Nature, in publ). Throughout this extraction and purification procedure the concentration of the cytochromes was constantly maintained above 5×10^{-6} M. Using this method, *the reduced form* (possibly the natural state within the living cell) of cytochrome-552 was isolated from light-grown Euglena cells, and the *reduced form of cytochrome-556* was isolated from dark grown, heat bleached and streptomycin induced Euglena's mutant cells.

THE APPLICATION OF PHENOL (C_6H_5OH) IN DETERMINING
TRUENESS-TO-VARIETY OF WHEAT

T. G. Copeland, Jr., W. E. Walls, and F. A. Agnew,

Division of Plant Industry, Virginia Department of Agriculture

20. The Seed Section is constantly searching for laboratory or growth chamber tests to supplement the time consuming trueness-to-variety field tests. A chemical test using Phenol (C_6H_5OH) is a potential laboratory technique enabling variety seed technologists to ascertain variety purity of most Wheat varieties in a period of 20-24 hours.

The Phenol test appears to be based upon the presence and activity of an enzyme (or enzyme groups) of the phenol oxidase type which oxidize phenolic substrates in the bran coat to form dark-colored, insoluble pigment.

This color reaction in the bran coat enables the analyst to observe the color or proportion of colors characteristic of a given genetic variety.

BUCKWHEAT, *FAGOPYRUM ESCULENTUM*, A NEW HOST
OF THE KNOTWEED CYST NEMATODE, *HETERODERA WEISSI*

Paul L. Duke and Lawrence I. Miller,

Virginia Agricultural Experiment Station, Holland

8. *Heterodera weissi* was first described as a parasite of *Polygonum pensylvanicum*. Since it is known that several *Heterodera species* are confined to plants with one family, tests have been initiated in Virginia to determine whether the economic crops of the Polygonaceae are hosts of the knotweed cyst nematode.

The Japanese variety of buckwheat was grown in sterilized loamy fine sand soil, which was artificially infested with cysts of a Nansemond County, Va., population of *H. weissi*, collected from the roots of *P. pensylvanicum*. After 2 months, the buckwheat plants were removed from the infested soil and the roots washed and examined. Numerous females and cysts containing viable second stage larvae were observed on the roots, which indicated that the full cycle of nematode had been completed on buckwheat.

The isolate of the knotweed cyst nematode from Nansemond County, Va., may be a geographical variant of the described species from Beltsville, Md., because the larvae, males, and eggs of the Nansemond County, Va., population are slightly longer than those reported by Steiner in 1949 and Tarjan and Sasser in 1953.

SURVIVAL OF *EIMERIA ACERVULINA* OOCYSTS IN SUSPENSIONS IN THE LABORATORY

Marion M. Farr and David J. Doran,
Beltsville Parasitological Laboratory, Agricultural Research Service,
Beltsville, Md.

10. An investigation was carried to determine under what conditions oocysts of *Eimeria acervulina* would best survive in the laboratory. Sporulated oocysts were separated from debris by sugar flotation and sedimented in distilled water. One-half were suspended in 0.5 per cent potassium dichromate; the other half were freed of bacteria with antibiotics and transferred to sterile Ringer's solution. Part of each lot was refrigerated at 3° to 5°C; the other part was held at room temperature. As a measure of viability, the per cent excystation in vitro was determined periodically for each suspension. To obtain information on the infectivity of the refrigerated suspensions, oocysts therefrom were fed to one-month old chickens, the oocyst output was determined and the numbers discharged per oocyst fed were calculated.

During a period of 12.5 months there was no decrease in percentage of excystation in both lots of oocysts stored in potassium dichromate while there was a decline in excystation of the oocysts stored in sterile Ringer's solution. The bacteria-free suspension kept in Ringer's solution for 45 weeks was still highly infective, and the potassium dichromate suspension showed undiminished infectivity up to 54 weeks.

A COMPARISON OF THE GROSS MORPHOLOGY OF THREE POPULATIONS OF THE STING NEMATODE IN VIRGINIA

Betty J. Gray and Lawrence I. Miller,
Virginia Agricultural Experiment Station, Holland

9. The gross morphology of the Virginia 1 population of the sting nematode, *Belonolaimus* sp. was first described in 1962. Two other Virginia populations, from around corn roots, have been studied and their dimensions compared with the Virginia 1 population. The Virginia 2 population from the A. W. Horne farm near Smithfield, Va., were morphologically distinguishable from each other and from the Virginia 1 population. All 3 Virginia populations resemble each other more closely than they do the two described species, *B. gracilis* and *B. longicaudatus*.

The stylet length and the ratio of the stylet length to tail length of the males of the 3 populations were significantly different. The female body length of the Virginia 2 population was significantly longer than that

of the Virginia 1 and 3 populations. And, the tail of the females of the Virginia 3 population was significantly shorter than that of the Virginia 1 and 2 populations. The combined values of the males and females of each of the three populations showed a significant positive correlation between body length and length of stylet and between body length and length of tail. It is believed that the three Virginia populations of the sting nematode are geographical variants of an undescribed species.

FURTHER SELECTION OF NORMAL AND CHLORDANE-RESISTANT GERMAN COCKROACHES FOR RESISTANCE TO MALATHION AND DIAZINON

James McD. Grayson
Virginia Agricultural Experiment Station, Blacksburg

5. Selection of the German cockroach, *Blattella germanica* (L.), with Malathion and Diazinon was continued in the laboratory. Large nymphs were exposed to residual desposits of these materials on tempered Masonite and glass surfaces to obtain the desired kill. The criterion of selection was greater than 80% kill.

Doage-mortality data were periodically obtained for males and females from the selected strains. The procedure consisted of exposing adult cockroaches to the toxicant on No. 1 Whatman filter paper. The following levels of resistance were obtained for the females at LC-50 and LC-90, respectively, in the normal strain selected with Malathion: 13.3X and 24.8X in the F_9 generation, and 115.6X and 53.9X and in the F_{15} generation. Similarly, in the Chlordane-resistant strain selected with Malathion the values were 48.0X and 38.6X and in the F_{10} generation, and 113.4X and 55.3X in the F_{16} generation. The corresponding orders of resistance in the males were similar to those obtained for the females.

No significant resistance to Diazinon was indicated after 15 or 16 generations of selection.

SOIL MOISTURE AS INFLUENCED BY CROPPING AND IRRIGATION

E. M. Dunton, Jr., *Virginia Truck Experiment Station, Painter*

16. Soil moisture probably is most often the factor restricting plant growth on the Eastern Shore of Virginia. The soils of this area are light and sandy and mostly well drained. In the summer and fall when evapotranspiration is high, maximum crop growth is dependent on a consistent renewal of this soil moisture. With the usual depletion of subsoil moisture early in the

summer, this renewal is supplied to shallow-rooted vegetable crops largely through rainfall and irrigation

In some growing seasons, rainfall is adequate and irrigation is not needed. This was the case in 1962. There are growing seasons, such as 1961, when there are extended periods without an effective rain. It is during such dry spells that irrigation serves as an effective but not a complete substitute for rain. Soil moisture curves for the Irish and sweet potato, snap bean, corn and soybean growing seasons demonstrate the influence of irrigation and plants on soil moisture.

THE EFFECT OF GYPSUM, LIME AND FERTILIZER ON SOYBEANS IN SOUTHEASTERN VIRGINIA

D. L. Hallock, *Virginia Agricultural Experiment Station, Holland*

18. The effect of four rates of gypsum, three rates of fertilization, and two rates of lime on soybean yields and other characteristics was investigated on three soil types in southeastern Virginia. Results of a study in 1959 on Craven fine sandy loam, pH 5.0, medium in available Ca, Mg, and K, and high in P are given. This soil contained 1.4 percent organic matter in the surface. One ton per acre of lime significantly increased seed yields, seed size and amount of purple stain on the seeds. Rates up to 600 pounds per acre 0-10-20 fertilizer significantly reduced protein content in seeds.

A similar study was conducted in 1960 on Bladen fine sandy loam, pH 5.1, high in available Ca and Mg, medium in K, and low in P. This soil contained 10 percent organic matter. No response to any of the treatments was obtained.

In 1961, this study was repeated on Sassafras loamy fine sand, pH 5.0, medium in available Ca and K, low in Mg, and very high in P. This soil contained 1.6 percent organic matter. Lime significantly increased seed yield and percent oil in seeds. Protein content was slightly lower in seeds from fertilized plots.

At all locations no response was obtained to rates of gypsum up to 1200 pounds per acre.

FACTORS AFFECTING THE CONSUMPTION OF PROCESSED POTATO PRODUCTS

Olman Hee, *Economic Research Service, USDA, Washington, D. C.*

24. The potato industry up to the 1950-1960 decade was witnessing a continuing downtrend in per capita demand for potatoes. But a combi-

nation of events has since arrested the decline in potato consumption. The trend appears to have reversed itself. A significant factor in the upturn was a dramatic increase in the per person use of processed potato products. During 1956-1961, the increase in per capita use of processed potatoes was about $2\frac{1}{2}$ times greater than a decline in fresh. In a study of the influence of the demand factors, it was found that changes in tastes and preferences were the primary influences in the upsurge in per capita consumption of processed potato products. Price and income, while showing the right direction of relationship, fall far short in explaining the large increase in consumption of processed items. The changing pattern of total per capita potato consumption has altered price-and income-consumption relationships. Once the shifting pattern of consumption stabilizes, it is possible that changes in consumption of fresh and processed potatoes may be successfully explained by the price and income variables.

COLORADO POTATO BEETLE RESISTANCE TO INSECTICIDES ON THE EASTERN SHORE OF VIRGINIA

R. N. Hofmaster

Eastern Shore Branch, Virginia Truck Experiment Station, Painter

1. Intense DDT-dieldrin resistance was developed by Colorado potato beetles in the Painter-Nandua section of the Eastern Shore of Virginia by 1959. Since that time resistance has become rather widespread in Northampton and Accomack counties. Similar resistance also has been reported in the Long Island area of New York State.

Approximately 100 different chemicals of combinations of chemicals have been field tested at the Virginia Truck Experiment Station 1960-1962. Guthion (0.5 lb./A.) Sevin (1.0 lb./A.) and Phosphamidon (0.5 lb./A.) have all been used on a commercial basis with satisfactory results. Phosdrin, Dibrom and Trithion are quite effective as are several compounds not yet cleared for potatoes. WARF and other anti-resistant compounds have shown some promise but were definitely inferior to Guthion, Sevin or Phosphamidon.

The granular systemics, Thimet (phorate) and Di-Syston, banded at planting (2 lbs./A.) have given potato beetle protection through the forepart of the growing season. However, these chemicals appeared to lose their effectiveness against potato beetles about 10 weeks after application and may need to be supplemented with foliage sprays. This especially is true in areas in which a partial second brood occurs on Irish potato.

A DISCUSSION OF THE DOCTRINES GOVERNING THE USE OF
WATER IN THE CONTINENTAL UNITED STATES
WITH SPECIAL REFERENCE TO VIRGINIA

Carl J. Holcomb, *Department of Forestry and Wildlife, VPI*

26. The use of water in the United States is governed by two doctrines, the riparian doctrine in the east and the doctrine of prior consumption in the 17 western states. Riparian law allows the owner of land on water-courses to use water for domestic purposes, but he is enjoined from impairing either the quantity or the quality of water for downstream use. Under a strict interpretation of the riparian doctrines most water in a stream would flow to the sea. It is commonly believed that we inherited the doctrine from English common law. There is strong evidence, however, that the doctrine came to us from the Napoleonic Code which in turn evolved from the Code of Justinian. The doctrine of prior appropriation recognizes that the person first using water from a stream has a vested right in it, for any purpose, and not necessarily on riparian land. Under the water appropriation doctrine a large proportion of water is being used for irrigation with too little available in many areas for expanding industrial and domestic use. In many states changes are taking place, the effect of which is allocation of water to more beneficial uses. This trend also is taking place in Virginia.

DISTRIBUTION OF DEFECTS IN BLACK CHERRY
CAUSED BY PHYTOBIA PRUNI (GROSS.).

K. M. Kulman, *Virginia Agricultural Experiment Station, Blacksburg*

25. Solid-Wood defects in black cherry, *Prunus Serotina* Ehrh., have been attributed to many causes, but the defects occurring in the commercial range of this species generally have been considered to be caused by the dipterous cambium miner, *Phytobia pruni* (Gross.) Close examination of defects in cross sections cut from several leavels in balck cherry trees in West Virginia has shown that the cambium miner defects occur in a definite pattern relative to the age of the wood-gorming cambium and height of the tree. At the base of the trees, pith flecks were restricted to wood produced by cambium under 13 years old, but higher in the tree pith flecks occurred in wood produced by cambium up to 30 years old. Detailed studies were made of the structure of the flecks with special emphasis on the characteristics that distinguished them from defects caused by the peach barkbeetle, *Phloeotribus liminaris* (Harris).

SEBACEOUS GLANDS OF SHEEP AND GOATS

Lubow A. Margolena

*Sheep and Fur Animal Research Branch, AHD, ARS, USDA,
Beltsville Md.*

31. The sebaceous glands of sheep and goats seem to persist and to function throughout life irrespective of breed and location. In follicles that contain shedding hair or wool, that portion of the follicle stretching from the level of the sebaceous gland to the orifice at the surface of the skin also is permanent. Glands associated with the primary follicles are developed during the third fetal month; those associated with the secondary follicles are established at a later date.

The length of the individual gland is not closely related to the size of the follicle which bears it, but uniformity of the glands is associated with the uniformity of the follicular population. The larger sebaceous glands, that is glands associated with the primary follicles, after Bouin or formalin fixation, measure 0.250-0.315 mm in length in Toggenburg does; 0.250-0.375 mm in Merino and Hampshire sheep; and 0.330-0.450 in Angora does and Rambouillet rams.

Lecithin or closely related lipines were habitually present in the hypodermal and subcutaneous fat, but not in that of the sebaceous glands.

VARIATION AMONG HOMOZYGOUS DWARF, HETEROZYGOUS
NORMAL BEEF CATTLET. J. Marlowe, *Virginia Polytechnic Institute*

27. Many gross abnormalities are apparent in the dwarf, particularly in the skeletal system. Bioassays for growth hormone showed a deficiency in the dwarf. This deficiency is expressed in the growth pattern by decreasing growth rate, weight, and body measurements at all ages, and through abnormal bone development. A similar but less extreme deficiency is expressed in carrier and suspect cattle in the form of decreased height and weight and increased chest/height ratio and conformation score. The dwarf gene also expresses itself through earlier development of masculinity in bulls.

Bioassay for adrenal, gonad and thyroid stimulating hormones and blood analysis as indicators of thyroid and parathyroid activity failed to reveal significant differences among dwarf, carrier and clean animals. Comparisons of numerous other blood constituents failed to reveal any significant differences.

Microscopic examination of more than 1000 slides of numerous tissues, glands, and organs from postnatal and 700 slides of prenatal dwarf, carried, and clean calves failed to reveal any significant histological differences.

A study of within group variance in body weight, measurements, grade, and masculinity score showed that carriers, offspring of carriers, and other suspect cattle carried significantly more than either homozygous normal cattle.

GENETIC AND ENVIRONMENTAL FACTORS AFFECTING BIRTHS IN SHEEP

Edward A. Mechling, II. and R. C. Carter, *Virginia Polytechnic Institute*

30. Frequency of multiple births increased with age of ewe to four years of age with little change at older ages. Lamb survival was higher at older ages, 7-8 years. More twins were born in October, and late January and February, than in November, December, early January or March. Dorsets were more prolific (53% multiple births) than Hampshires (37%) or Southdowns (42%). Grade and crossbred ewes were more prolific than purebreds. Ewes lambing first as yearlings were as prolific at later ages as those lambing first at two and three years of age. Estimates of repeatability of twinning averaged about 15%. The ewes first lambing record was as good a predictor of future performance as second or third records. Heritability of twinning was low and not significantly different from zero. Twin ewes born as first lambs produced a higher proportion of twins than twins born at second, third or subsequent lambings.

ADJUSTABLE EQUIPMENT FOR SEPARATE COLLECTION OF EXCRETA FROM BARROWS

D. P. Morgan and R. J. Davey,
Swine Research Branch, AHRD, ARS, U.S.D.A., Beltsville, Md.

15. Equipment described was evolved over several years of swine nutrition studies involving trace minerals and energy metabolism at the Agricultural Research Center, Beltsville, Maryland. This metabolism equipment has proved suitable for separate collection of total urine and feces from male swine ranging in size from 35 to 200 pounds. Adjustable cakes floored with stainless steel screen allow voided urine to be collected on polyethylene film catch panels and funneled into collection jars. Feces are collected in polyethylene bags secured to the pig by an adjustable harness and interchangeable hoop arrangement which permits easy changing of the bags. A period of two days in the cages preliminary to actual

collection accustoms most animals to the cages if they are already conditioned to the feeding regimen. Failures of total collection have been less than five percent.

COMPARATIVE RESPONSE OF ALFALFA TO TOPDRESSED SUPERPHOSPHATE AND PHOSPHATE ROCK

W. W. Moschler and G. D. Jones

Virginia Agricultural Experiment Station, Blacksburg

19. Alfalfa yields were increased 133 percent in a 4 year period by a topdressing application of phosphate rock to an established alfalfa stand on a phosphorus deficient soil. The efficiency of this material when topdressed was previously unreported. It compares favorably with that of topdressed superphosphate though yields from superphosphate are higher per pound of phosphate applied. The response of alfalfa to topdressed phosphate rock was only 13 percent on soil previously receiving an application of phosphate rock. Determinations of chemical transformations of the topdressed phosphate rock revealed the formation of iron and aluminum phosphates but very little penetration of them into the soil profile.

DRYING RATE AND QUALITY OF HAY PRODUCED WITH A SELF-PROPELLED WINDROWER-CONDITIONER

Tin M. Nyunt and Floyd M. Cunningham

Virginia Agricultural Experiment Station, Blacksburg

21. Performance of a 12-foot, self-propelled windrower-conditioner was studied at Blacksburg in 1962. For comparison, the more commonly used crusher-type conditioner and flail-type chopper also were tested simultaneously in the same alfalfa field with plots assigned to machines in a randomized-block statistical design.

Moisture measurements of second and third cuttings during field curing show that hay produced with the windrower-conditioner was 4 hours to one day slower in drying to a 20% moisture content. The slower drying appears to be due partly to lower conditioning roll pressure of 4.4 pounds per inch compared with 11.0 pounds per inch for the crusher.

Drying rates of turned and unturned windrows prepared with the windrower-conditioner were not significantly different and both graded U.S. No. 1 hay. Other treatments graded U. S. No. 2 mainly because of loss of green color. Chemical analysis of samples of the third cutting 3 months after baling showed that crude protein content of windrow-conditioned hay was up to 2% greater than other treatments and that differences in estimated net energy content were small. Field losses of

dry matter were less with the windrower-conditioner, especially for the fourth cutting where growth was too short for effective windrowing with a side delivery rake.

VIBRIO FETUS ENDOTOXIN AND HYPERSENSITIVITY

J. Clark Osborne, and R. M. Smibert

Virginia Agricultural Experiment Station, Blacksburg

12. Vibriosis was first described in 1909 as a disease of sheep. From 1918 to 1923, Dr. Theobald Smith described the disease in cattle and studied many facets of the disease. In animals the disease is responsible for epizootics of abortion and lowered fertility, and it is cosmopolitan in distribution.

Vibrio fetus, the fastidious Gram-negative bacterium that causes this disease has been shown in our experiments to elaborate an endotoxin-like substance. Cattle appear to be nearly 100% naturally hypersensitive to *V. fetus* whole-cell inoculums or supernatant fluids from broth cultures. Intravenous inoculation of either a whole-cell inoculum or supernatant fluid of *V. fetus* cultures produced an anaphylactoid shock syndrome that varies in severity from mild to lethal depending upon the amount of inoculum administered. A vascular crisis is apparently triggered by the creation of a defect in the blood clotting mechanism. Pulmonary edema and hemorrhage are prominent gross lesions noted at necropsy.

The demonstrated naturally occurring *V. fetus* hypersensitivity is considered to be a major facet of the pathogenesis of vibriosis. Knowledge of this hypersensitive state should lead to improved diagnostic therapeutic and prophylactic control measures for the disease.

EXERCISE AND INSTRUCTION IN SOIL SCIENCE FOR HIGH SCHOOLS

John D. Pendleton, *Virginia Polytechnic Institute*

34. Soil Science deals with the application of principles of chemistry, physics, geology, and biology. Excellent illustrations of the working of a large number of such principles are provided by the soils. Three examples are given.

The chemical states of oxidation and reduction were demonstrated with samples of dry and wet soils. The presence of oxidized iron (ferric) in the "high" sample and of reduced iron (ferrous) in the "low" sample were demonstrated with color tests. The significance of these conditions to the soil and plants can be shown.

A technique for simple chemical identification of potassium and calcium feldspars was demonstrated. The importance of this to "rock hounds" and the significance of the quantity of such minerals in soils to the inherent fertility of the soils was discussed.

As an example of a physical condition the moisture content of a soil was determined by making two weighings; the newly sampled moist soil, and the same submerged in water. The weight of the dry soil can be calculated from the weight of the submerged soil.

It is believed that use of such techniques and principles in high school can:

1. Interest students in the "life sciences".
2. Arouse greater interest in chemistry, physics and geology.

INFLUENCE OF ULTRAVIOLET, ULTRASONIC AND ELECTROMAGNETIC ENERGY ON SPINACH SEED

Thomas M. Roane and U. F. Earp

Virginia Agricultural Experiment Station, Blackburg

22. Spinach seeds were treated between two 6"x6" plates 1" apart at approximately 150 volt rms. Frequencies were 60, 500 and 900 cycles per second. Exposure times were 30, 60, and 90 seconds for each frequency. One sample was treated in an ultrasonic generator at about 40 kc for 1 minute. Another sample was soaked in water for 1 minute for the wet check. Ultraviolet radiation at about 3654 Å and 3129 Å was used on other treatments.

Four reps consisting of 100 seed each were germinated in a refrigerator at about 45 F. After 9 days and 13 days the germination of those treated ultrasonically, the wet check, and those exposed to about 3129 Å were significantly greater than for the other treatments including the dry check. After 31 days all of the treatments germinated above 85% and there was no significant difference for any of the treatments.

Four reps of eighty seed each were treated as previously indicated and planted in flats in the greenhouse. At 28 days they were thinned to 10 plants per tray. There was no significant difference in the 28 day emergence. Data regarding differences in crop yield for the various treatments were inconclusive.

COMPOSITION OF SWINE COLOSTRUM AND MILK: MAJOR CONSTITUENTS AND ZINC

V. C. Scarborough and I. P. Earle
AHRD, ARS, U.S.D.A., Beltsville, Md.

14. Analytical data are reported on samples of sow's colostrum and milk for total solids, fat, protein, phosphorous and zinc. The 25 animals from which samples were obtained were maintained throughout gestation and lactation on diets of natural feedstuffs unsupplemented with zinc.

The analyses on 25 samples of colostrum drawn from 0 to 12 hours after parturition, and 16 samples of milk drawn between 28 and 48 days of lactation are as follows: Colostrum: total solids, 27.18%; fat, 5.75%; protein, 16.74%; total phosphorus, 0.130%; zinc, 19.4 mg/kg. Mid-lactation milk: total solids, 17.86%; fat, 6.03%; protein, 6.24%; total phosphorus, 0.178%; zinc, 8.25 mg/kg.

Attention is called to the high content of zinc in sow's milk as compared with that which has been reported for milk of other species, i.e., cow, human and ewe. A range of 6.8 to 9.9 mg/kg zinc has been obtained for the sow as compared with one of 3 to 5 mg/kg for milk of other species.

Significance of the high zinc content of sow's milk in relation to the zinc requirement of the young pig is indicated.

GENETIC VARIATION IN CHICK BIOASSAYS FOR GONADOTROPINS

1. TESTES WEIGHT AND RESPONSE

P. B. Siegel and H. S. Siegel, *Virginia Polytechnic Institute*

28. Genetic influences on testes weight response to anterior pituitary homogenates and purified gonadotropins were studied in White Rocks. Preparations were subcutaneously injected with a saline carrier and responses measured as increase in testes weight/100 g. of body weight. Heritabilities were estimated from paternal half-sib correlations.

Significant differences among sire families were obtained from injections of anterior pituitary homogenates. Also significantly different were responses from sire families to 10 and 20/ug of FSH (Armour). The mean heritability of response to the two dosages was 0.92. Differences among sire families to injections of 100 and 200/ug of LH (Armour) was significantly greater than that obtained when either was 0.24.

Overall response to combination administration of LH and FSH (Armour) was significantly greater than that obtained when either was administered singly. In some sire families the response to combination injections was additive while in others it was similar to that obtained when either hormone was administered alone.

Differences between sire families were noted for injections of NIH-LH but not for NIH-FSH. Mean heritabilities were 0.03 for FSH and 0.80 for LH. Significant differences were also found among sire families for injection of each of two sources of PMS (Organon and Ferring).

GENETIC VARIATION IN CHICK BIOASSAYS FOR GONADOTROPINS.

2. HISTOLOGICAL AND HISTOCHEMICAL RESPONSES

H. S. Siegel and P. B. Siegel, *Virginia Polytechnic Institute*

29. Significant differences in seminiferous tubule diameters were not observed among newly hatched progeny of 5 White Rock sires in a range of 5 to 40 $\mu\text{g}/\text{chick}$ of FSH (Armour). However, significant differences were found when the range extended to 625 μg . Similarly, significant sire effects were observed with NIH-FSH levels ranging from 5 to 125 μg . Differences in tubule responses among families were not significant using NIH-LH at doses of 1 to 25 μg . Family rankings were not necessarily the same as rankings for testes weight responses.

Significant linear increases in tubule diameters were found in the 5 to 125 μg range for Armour FSH. When sire differences were considered, precisions (λ) for these assays were 0.35 and 0.11, respectively. A significant quadratic response was obtained when dosage was increased to 625 μg and indicated that this was above effective assay limits for this method. Precisions with NIH-FSH and LH were 0.23 and 0.25, respectively.

No family differences were noted in lipid content, but 25 $\mu\text{g}/\text{chick}$ of LH caused lipid depletion and stimulated nuclear activity in the interstitial tissue. By contrast, the FSH sources employed increased interstitial sudanophilia. Although FSH stimulated tubule growth, increased nuclear activity was not observed.

PEANUT RUST IN VIRGINIA GROVER C. SMART JR.

Virginia Agricultural Experiment Station, Holland

2. Peanut rust, caused by *Puccinia arachidis*, was observed for the first

time in Virginia in October, 1961, on one farm in Southhampton County and one farm in Nansemond County. The rust fungus infects and forms urediospores on leaflets, petioles, and branches of peanut. Those plants in areas of primary infection were killed, but plants infected from spores produced in these areas of primary infection were not severely damaged at the time of harvest. It is believed that if peanut rust were to develop to epidemic proportions by the first week in September, it could cause catastrophic losses. The occurrence of peanut rust was preceded by hurricane winds several weeks prior to discovery of the rust. The peanut rust fungus is not known to overwinter in the United States, so it is assumed that primary infections were caused by spores from infected plants in the West Indies. Primary infection sites also could have originated from spores developed in one of the states south of Virginia if rust occurred there long enough prior to its presence in Virginia. No rusted peanut plants were observed in Virginia in 1962.

PHYSIOLOGICAL RACES OF *DITYLENCHUS DESTRUCTOR*, THE POTATO ROT NEMATODE, AND THE EFFECT OF PHOSPHORUS AND POTASSIUM ON REPRODUCTION

Grover C. Smart, Jr., *Virginia Agricultural Experiment Station, Holland*

7. Four isolates of *D. destructor* obtained from 4 different host plants in widely separated geographic areas could not be distinguished morphologically. All of the isolates interbred. Differences exhibited in pathogenic effects on potato, dahlia, and St. Augustine grass, however, warranted classifying the 4 isolates as physiological races of *D. destructor*. The effects of phosphorus (P) and potassium (K) on the reproduction of *D. destructor* was tested by growing the nematode on the fungus, *Oidiodendron nigrum*, cultured on agar media varying in levels of P and K. The basal medium (BM) contained 165 ppm P and 208 ppm K with concentrations of the other major and the minor mineral elements also held constant. When levels of P were tested, K was held at the BM level and conversely. Levels, in ppm, of P and K tested were: P-0, 16.5, and 495; K - 0, 20.8, and 624. Nematode populations were lower at levels of P and K below the BM and K above the BM, but populations were higher at the P level above the BM. It is postulated that the varying levels of P and K influenced the rate of oviposition and/or the length of the life cycle of *D. destructor*.

HIERARCHICAL STRUCTURE IN THE PEDIGREE BREEDS OF LIVESTOCK

Kitty Phillips Smith and Robert C. Carter, *Virginia Polytechnic Institute*

32. The hierarchical structure among breeders and flocks in the Hamp-

shire breed of sheep was studied using random samples of lambs born in 1945 and 1955 from the American Flock Book. Only 15% of the lambs in the 1955 sample and 10% in 1945 were sired by rams bred by the breeder of the lamb in the sample, indicating that most breeders purchase their herd sires. The top or sire line of the pedigree (sire, grand sire, great grand sire, etc.) was traced to the imported foundation animal. In 1945 half the lines traced to three breeders by the fifth generation and more than one-half in 1955. Eighty percent of the sire lines in the 1955 sample traced to five imported rams and 65% in 1945. This indicates an hierarchical structure with only a few breeders at the top who furnish rams to the majority of breeders of lower rank who in turn sell to non-pedigree producers.

EXPERIMENTAL ERADICATION OF THE SWINE KIDNEY WORM, *STEPHANURUS DENTATUS*, By HERD MANAGEMENT¹

T. B. Stewart², O. M. Hale³, B. L. Southwell³, J. S. Andrews⁴,
W. N. Smith², and D. J. Jones²

(Presented by J. S. Andrews)

11. A method is described for eradicating the swine kidney worm from southern pastures by the use of gilts only in the breeding herd and their disposal at the time their pigs are weaned.

A helminth-free south Georgia pasture was contaminated with kidney worm eggs from May 30, 1958 to May 25, 1959. Of the test pigs farrowed by the sows with patent infections, up to 75 per cent of those maintained on the area during the suckling period and up to 100 per cent of those remaining on the area until they weighed about 200 pounds, developed kidney worm infections. Seventeen and 75 percent of the livers of the 1959 spring-farrowed pigs in these two groups, respectively, were condemned because of kidney worms.

Of the test pigs farrowed by gilts in the fall of 1959, only 17 per cent of those maintained on the pasture during the suckling period and only 50 per cent of those remaining until they attained market weight became infected with kidney worms. No livers were condemned. The 1960 spring-and fall-farrowed pigs from comparable gilts similarly main-

¹From the Animal Disease and Parasite Research Division, Agricultural Research Service, United States Department of Agriculture and the Georgia Coastal Plain Experiment Station, Tifton, Georgia.

²Parasite Laboratory, ADP, ARS, Tifton, Georgia.

³Animal Husbandry Department, Georgia Coastal Plain Experiment Station, Tifton, Georgia.

⁴Beltsville Parasitological Laboratory, ADP, Agricultural Research Service, U.S.D.A., Beltsville, Maryland.

tained on the area remained kidney worm-free. The infestation of the pasture with other parasites was not decreased.

THE HYDROLYSIS OF IRON IN CATION EXCHANGERS

Grant W. Thomas, *Virginia Agricultural Experiment Station, Blacksburg*

17. The absence of naturally-occurring exchangeable ferric iron in soils would suggest that it is unstable. Experimental investigations on mineral clays and soils showed that hydrolysis occurs with the formation of hydrogen ions and hydroxy-ferric ions. The exchangeable hydrogen ions are unstable and cause the destruction of the clay with the result that cations from the octahedral layer appear on the exchange sites. In the case of montmorillonite, the cation is aluminum, in hectorite, magnesium and in nontronite, iron. The hydroxy-ferric ions tend to block exchange sites as hydrolysis proceeds. This reaction appears to be an important pathway of iron oxide accumulation and cation-exchange capacity diminution in soils.

BEHAVIOR PATTERNS IN GAME BIRDS FROM SIX TO THIRTEEN WEEKS OF AGE

F. C. Wiley, III and P. B. Siegel,
Virginia Polytechnic Institute and Roanoke College

33. This experiment was designed to determine various behavior patterns within flocks of game birds and the development of peck-rights within these groups. The birds were separated according to sex and were maintained in three replicate pens. Determination of the sequence of behavior patterns was conducted for a seven-week period during which the birds progressed from six to thirteen weeks of age. Data were obtained for stretches, runs, frolicks, spars, peck-avoidance, threat-avoidances, avoidances and fights and analyzed by analysis of variance. Peck orders were obtained weekly from each flock until peck-rights appeared definitely established.

No significant differences were found among ages or sexes for frolicking, avoidances or sparring no were the interactions between these variables significant. Females stretched significantly more than males, whereas threat-avoidances, fights, and total agonistic behavior were significantly greater among males than females. A significant sex-age interaction existed for stretching, running, threat-avoidances and fighting. Stable peck-orders were formed about two weeks earlier than in domestic chickens.

STUDIES ON THE MECHANISM OF ARSANILIC ACID
TOXICITY IN THE CHICK

E. L. Wisman, *Virginia Agricultural Experiment Station, Blacksburg*

13. Varying levels of arsanilic acid and its sodium salt were administered in the feed and drinking water, respectively, of broiler cockerels to four weeks of age. The level of 90 gms. of arsanilic acid per ton of feed is FDA approved for stimulating growth and improving feed conversion.

Environmental conditions in these studies did not permit any significant growth response to any level of arsanilic acid or its salt. Eight times this level, and higher, progressively depressed growth, with the water administration being more acute. One-tenth per cent of sodium arsanilate in the drinking water produced thiamine-like deficiency symptoms, but subsequent studies showed that excess dietary thiamine did not prevent arsanilic acid toxicity.

The hypothesis that the arsenic of arsanilic acid competes with phosphorus in the formation of coenzyme A was not confirmed by chick growth assay. Additional dietary phosphorus did not influence high-level arsanilic acid toxicity.

When fed at the growth stimulatory level of 90 gms. per ton of feed, arsanilic acid did not show any sparing action of any of the water-soluble vitamins. The acceptable theory that arsanilic acid stimulates chick growth by affecting the microflora was not confirmed by these studies, but there are other possible biochemical mechanisms that need to be checked.

SECTION OF ASTRONOMY, MATHEMATICS
AND PHYSICS

B. W. Slope, *Chairman*,

W. T. Joyner, *Secretary*

I. Boggs, *Historian*

D. Rae Carpenter, Jr., *Section Ed.*

E. F. Turner, Jr., *Council Representative*

MINUTES

The business meeting was opened with general announcements by the Chairman, B. W. Slope. The section editor brought up the matter of the increasing length of the program. Several suggestions were discussed. In the event of further increase in the number of papers submitted, the sec-

tion will probably go to simultaneous Friday sessions. The section editor also called for news and notes of departmental activity, personnel changes, honors and grants to be published in the Journal.

It was moved and seconded that the secretary send a letter of appreciation to Miss Isabel Boggs for her past service as historian of the section.

The Chairman called for the report of the nominating committee which consisted of Dr. A. D. Campbell, Dr. T. Gilmer, and Dr. A. Robeson. Dr. Campbell presented the recommendations of the committee for officers for the year 1963-1964 as follows: *Chairman*, W. T. Joyner, Hampden-Sydney; *Secretary*, Dexter Whitehead, University of Virginia; *Council Representative*, E. F. Turner, Jr. Washington and Lee; *Section Editor*, D. Rae Carpenter, Jr., VMI; *Historian*, D. Rae Carpenter, Jr., VMI.

It was moved, seconded and passed that these recommendations be accepted. There being no nominations from the floor, the above slate of officers was elected unanimously.

W. T. Joyner, *Secretary*

A ROTOR CLOCK

J. W. Beams, *University of Virginia*

2. A number of experiments would be made possible if a more constant speed rotor or a rotor which decelerates very slowly when coasting freely, could be devised. The deceleration of a properly magnetically suspended rotor when coasting freely in air at a pressure of 10^{-9} torr, is found to be about 10^{-9} sec $^{-1}$. Experiments are described in which an inner rotor is magnetically suspended from an outer rotor which in turn is magnetically suspended. The outer rotor surrounds the inner rotor. Consequently when the inner rotor and the outer rotors are spun at the same speed in the same direction both the magnetic suspension and the vacuum chamber surrounding the inner rotor spin at the same speed as the inner rotor. As a result the gaseous frictional drag on the inner rotor and any friction due to the magnetic suspension are vanishingly small. This arrangement makes possible a very constant speed rotor especially for short times which may be used as a precise clock.

PHOTONEUTRON CROSS SECTIONS FOR LIGHT ELEMENTS

Lee N. Bolen and K. Min, *University of Virginia*

17. The absolute (γ, n) cross sections of natural silicon, phosphorus, sulfur, oxygen, and aluminum have been measured using the bremsstrahlung from the 70 Mev synchrotron at the University of Virginia. Yield

points were taken at 0.5 Mev intervals from 12 to 30 Mev in each case. The absolute measurements were made utilizing a Halpern type detector, a modified version of a N. B. S. ionization chamber, and a calibrated Ra-Be neutron source. A minimum of 20 runs were made for each element with less than 1% standard deviation in the yield points contributed by the major isotope. The data were analysed from 12 to 30 Mev by the Leiss Penfold technique using two interlacing 1-Mev bin widths. Preliminary results show that each cross section is composed of several discrete resonances, with at least four resonances resolved in each cross section. The Si, P, and S cross sections displayed maximum values of approximately 14.5, 14.0 and 11.5 mb, respectively. For oxygen, maxima occur at 17.3, 19.3, 22.5, and 24 Mev with indications of further resonances at 26.5 and 28 Mev; the maximum value of the cross section is 8.6 mb at 22.5 Mev. The aluminum cross section displays resonances with 10.6, 12.7, and 12.7, and 12.7 mb maxima located at 18.2, 19.9, and 21.4 Mev. (Work supported by the United States Atomic Energy Commission.)

MULTIDETECTOR ARRAYS FOR CHARGED PARTICLES

Andrew P. Borden, *University of Virginia*

18. A simple scheme for using a single amplifying system with two or more surface barrier type semiconductor detectors has been further investigated. [E. A. Wolicki and A. R. Knudson, *Rev. Sci. Inst.*, 33, 1132 (1962).] Using two similar detectors, spectra of α particles and spectra of (d,p) reactions were studied. Experimental results were obtained relating the resolution of detectors in array to the per cent of separation of the peaks. It has been shown that an array of three or more detectors can in some cases be successfully used for proton detection in angular distribution measurements on (d,p) reactions. Present plans are to use an array for proton detection in angular correlation studies of d, p γ reactions.

A METHOD FOR EXTRACTING THE j' th FOURIER HARMONIC INDEPENDENTLY FROM A SET OF POINTS (x_i, y_i) COMPATIBLE WITH THE LEAST SQUARE CONDITIONS

Charles M. Bowden, *University of Richmond*

4. Assuming the set (x_i, y_i) is complete and that the x_i are all evenly spaced and all the y_i are independent, a least square curve is fitted to the points:

$$y = \sum_j a_j \sin(jx + \phi_j)$$

where the least square parameters are the a_j and ϕ_j .
It was shown that the normal equations

$$\frac{\partial}{\partial a'_j} \left\{ \sum_i [y_i - \sum_j a_j \sin(jx_i + \phi_j)]^2 \right\} = 0$$

$$\frac{\partial}{\partial \phi'_j} \left\{ \sum_i [y_i - \sum_j a_j \sin(jx_i + \phi_j)]^2 \right\} = 0$$

reduce to give expressions for a'_j and ϕ'_j respectively involving only the measured quantities x_i and y_i .

$$a'_j \sin \phi'_j = \sum_i y_i \cos j' x_i / \sum_i \cos^2 j' x_i = A(j')$$

$$a'_j \cos \phi'_j = \sum_i y_i \sin j' x_i / \sum_i \sin^2 j' x_i = B(j')$$

So: $a'_j = [A^2(j') + B^2(j')]^{1/2}$ and $\tan \phi'_j = A(j')/B(j')$

The Gauss condition is given as a test of validity, i.e., the greatest harmonic, j'' , which is valid is given by the following condition:

$$\sum_i [y_i - \sum_j a_j \sin(jx_i + \phi_j)]^2 / n - 2j'' = \text{minimum}$$

Where n is the total number of pairs (x_i, y_i) .

The above development also shows that the least square sine curve solutions to the set (x_i, y_i) gives the Fourier harmonic to the least square curve through the points, the number of the harmonic depending on the choice in frequency $f = j'x/2\pi t$.

SURFACE CHARACTERISTICS OF THE MOON DEDUCED FROM RADIOMETRIC MEASUREMENTS

Charles M. Bowden, *University of Richmond*

12. The need for better measurements in the range from the millimeter through the entire centimeter region of the electromagnetic spectrum was cited. A theoretical model based upon a homogeneous substance for the lunar surface was given. The constants of the theory were evaluated using the radiometric measurements at 3.15 cm. wavelength given by Bowden and Mayer; the following theoretical expression results for the brightness temperature distribution over the moon:

$$T_e(\theta, \phi, t) = .9 \{ T_m + .44 (T_s - T_m) \cos^{1/4} \phi + .09 (T_s - T_m) \cos^{1/4} \phi \} \cos(wt - \theta - \xi)$$

Where:

T_m = Midnight point surface temperature

T_s = Subsolar point surface temperature

θ and ϕ are respectively the selinographic longitude and latitude

ξ = the phase lag of the peak of the radio emission to the longitude of the position of subsolar point on the lunar surface.

Also: $\tan \xi = \delta / 1 + \delta$ where δ is the ratio of the thermal wave attenuation to the electromagnetic wave attenuation.

The possibility of interpreting startification and inhomogenaities in the lunar surface structure upon applying the theory to measurements over a wide range of wavelengths was discussed.

MEASUREMENT OF THE INFINITE MULTIPLICATION FACTOR FOR A SUBCRITICAL ASSEMBLY

T. W. T. Burnett and T. G. Williamson, *University of Virginia*

22. A simple technique has been used to measure the infinite multiplication factor in the University of Virginia light water, natural uranium subcritical assembly.

It is based on the volume integral of the thermal neutron flux over all space in the equivalent infinite assembly. For a source of S fast neutrons per second, this integral is

$$\frac{S \epsilon' \epsilon p}{\Sigma_a (1 - k \infty)}$$

where ϵ' is the neutron gain from source energy to fission energy.

Experimental error in the evaluation of the integral may be very large because the larger part of the integrated flux is outside the boundaris of the actual assembly. Error in the infinite multiplication factor is much smaller than in the flux volume integral. The error can be reduced by poisoning the system.

This method has been found to give a value for the infinite multiplication factor which agrees as well with other methods and calculation as they agree with each other.

PLASMA OSCILLATIONS AND CONDUCTION PHENOMENA IN A PENNING IONIZATION GUAGE

Frederic R. Crownfield, Jr., *College of William and Mary*

3. Interactions have been observed between plasma oscillations and the

anode current drawn by a Penning Ionization Guage [F. R. Crownfield, Jr. and R. N. Dennis, Jr., Bull. A.P.S. 7, 641 (1962).] A description was presented of these phenomena and of attempts to understand them in terms of coupled oscillations.

ON MAGNETIC FIELD HOMOGENEITY WITH AIR CORE COILS

Frederic R. Crownfield, Jr., *College of William and Mary*

5. Simple considerations show that two identical coils of finite cross-section arranged as a Helmholtz configuration may be arranged to give a given degree of homogeneity over a larger region than that obtained by causing the second derivative of B with respect to z to vanish at the mid-plane. The procedure will be described and numerical results presented.

ELECTRON-MICROSCOPE STUDIES OF FRACTURE IN THIN RIBBONS OF CADMIUM

J. C. Crump, III, and J. W. Mitchell, *University of Virginia*

30. Electron transparent ribbons of cadmium have been grown from vapor faces are parallel to (0001) planes and their edges lie along (11 $\bar{2}$ 0) by the slow distillation of cadmium in an atmosphere of argon. Their sur-directions. They are approximately 1200 Å thick, 20 μ wide and 1 mm long. Tension was applied to these ribbons along a (11 $\bar{2}$ 0) direction with a pneumatic tensile device while they were under examination in a Philips EM 100B electron microscope. The elastic strain was determined directly from measurements on the diffraction patterns. As these crystals are of uniform rectangular cross section, the corresponding stress must be uniform. The ribbons observed have been initially free of dislocations. Many of these ribbons fail by fracture at measured elastic strains of 4% without the appearance of any dislocation phenomena. These are expected to be nearly perfect crystals entirely free of foreign particles. Other ribbons show dislocation-multiplication phenomena at lower strains and also develop vacancy-type dislocation loops while being examined in the electron microscope. These ribbons usually fail by fracture at measured strains of about 2.5%. (Work supported by the U. S. Atomic Energy Commission and Office of Naval Research.)

AXIAL DISLOCATIONS IN RIBBONS OF ALUMINUM NITRIDE

C. M. Drum and J. W. Mitchell, *University of Virginia*

29. Small crystals of aluminum nitride have been grown by sublimation at temperatures in the vicinity of 2000°C in pure nitrogen. The presence of an axial dislocation in a large proportion of the filamentary crystals has

been established by transmission electron microscopy, and the Burgers vectors have been determined by diffraction contrast techniques. Blade-shaped filaments with large surfaces parallel to the basal plane grow along a $(10\bar{1}0)$ direction, and the Burgers vectors of the axial dislocations lie along a directions at 30° to the dislocation line. Blade-shaped filaments with large (1010) surfaces grow along a $c + 2a$ direction and contain axial dislocations with Burgers vectors along the c direction at 52° to the dislocation line. Twisting has not been observed in these crystals, although several independent methods have been used to detect it. It is concluded that direct observations have been made of the axial dislocations that were probably important in the growth process. Since many filaments have been found to be free from dislocations, it is not obvious from this study that the axial dislocation is necessary for the growth of all of the filamentary forms. (Work supported by the United States Atomic Energy Commission.)

THE GROWTH AND ETCHING OF CRYSTALS OF ZINC AND CADMIUM

K. G. Everett, R. A. Paddock and J. T. Ratchford,
Washington and Lee University

24. Two modifications of the Bridgman technique for growing single crystals from the melt have been used to grow high purity zinc and cadmium single crystals. The first method consists of moving a furnace along a stationary crucible containing the melt. The furnace is maintained at a temperature above the melting point of the metal, and is moved at a linear speed of about one inch per hour. The second and better method uses a growth furnace with multiple winding. The desired temperature gradient is established in the furnace, and is then moved up the furnace by controlled reduction of the energy input. No mechanical movement of furnace or crystal is involved, eliminating the vibrations which were unavoidable with the first method. The growth crucibles were pyrex glass tubing, coated with mold release agents and evacuated to 10^{-5} to 10^{-6} mm Hg. Commercial silicone-base release agents have been found adequate. Etchants for revealing grain boundaries, when present, as well as chemical polishes for zinc and cadmium have been used successfully. (Supported by the National Science Foundation and the R. E. Lee Research Fund.)

AN ATTEMPT AT A "MATHEMATIZATION" OF CERTAIN TRUTH FUNCTIONS

Herta Aussig Freitag, *Hollins College*
and Arthur H. Freitag, *William Fleming Senior High School*

23. The truth table for implicative propositions is examined from a mathematical point of view. It is suggested that the logician uses the terms *true* and *false* to symbolize several somewhat distinct meanings.

MAGNETORESISTANCE IN SINGLE CRYSTALS OF COPPER

A. J. Funes and R. V. Coleman, *University of Virginia*

33. There is a connection between the transverse magnetoresistance of single crystals and the topology of the Fermi surface. This is true when the Fermi surface comes into contact with the first Brillouin zone, as it does in copper, silver and gold.

Because of this contact, the transverse magnetoresistance shows a large anisotropy as a magnetic field is rotated in the plane perpendicular to the current*. Experimental diagrams of resistivity vs. orientation of the magnetic field show peaks centered around the low index poles. These peaks are associated with the existence of regions of open orbits.

With 16 crystals of different orientations, we have been able to draw the stereographic projection of the two dimensional regions, and the one dimensional regions of open orbits for copper.

In addition, from the angular width of the two dimensional regions around the (001) and (110) poles, we have calculated the size of the necks of contact between the Fermi surface and the first Brillouin zone.

We find neck thicknesses of .29 (a/a) in the $[1\bar{1}0]$ direction and .26 ($a/2$) in the $[112]$ direction. (a =reciprocal lattice vector).

A MEASUREMENT OF THE MEV REGION NEUTRON SPECTRUM FROM THE UTR-10 REACTOR

A. K. Furr and R. S. Runyon, *Virginia Polytechnic Institute*

19. A recoil proton telescope has been designed to detect fast neutrons. Incident neutrons in a well collimated beam scatter protons from a thin hydrogenous annular ring with the recoil protons being detected by a silicon diode. The diode is shielded from the direct beam of neutrons and gamma radiation by a central plug of lucite and lead in order to eliminate events arising in the diode itself from the direct radiation. An efficiency

of 10^{-6} to 10^{-7} is obtained depending on the radiator used and the neutron energy. This has allowed measurements to be made of the neutron flux in the UTR-10 reactor from 0.7 to 4.7 Mev with a resolution of about 250 to 150 kev over this energy range.

THE INFRARED ABSORPTION SPECTRUM OF LITHIUM-DOPED SILICON

T. E. Gilmer, Jr. and R. J. Bell, *Virginia Polytechnic Institute*

27. Liquid helium temperature range experiments using far infrared absorption coefficient measurements show that shallow donor type impurity centers are present in lithium doped silicon. The ionization energy associated with the strongest series of absorption peaks is 39.2 ± 0.3 mev. The transition probabilities, full widths at one half the peak absorption coefficients, and the energy differences between the p-levels are in good agreement with previous experiments on other impurities and the Kohn-Luttinger shallow donor theory.

The samples contained about 10^{17} oxygen atoms per cc, and it is thought that lithium-oxygen complexes are affecting the observed results.

In addition, time-concentration, temperature, and effects produced by crystal symmetry were probably observed.

The ionization energy of 39 mev is in plausible agreement with the previously-measured thermal value of 33 mev for lithium doped silicon.

CHANGE OF OPTICAL PROPERTIES OF THIN METAL FILMS DUE TO EXPOSURE TO GASES

H. H. Hsu, J. W. Sherman and H. Y. Loh, *Virginia Polytechnic Institute*

25. Optical properties of thin metal films have been studied in vacuum and then in different gases; namely, air, nitrogen, argon and oxygen. They showed definite changes due to the exposure to the gases. Generally, the change seemed to consist of two stages; a rapid initial stage which may last only for a fraction of a minute, and a slow gradual stage which may take a long time. Experimental results are presented and the mechanism for such changes is discussed.

A STUDY OF PARAFFIN SHAPES WITH PULSED NEUTRONS

Y. P. Hwu, H. D. Curet and A. Robeson, *Virginia Polytechnic Institute*

20. A study of neutron diffusion in paraffin shapes has been undertaken using the V.P.I. 250 KV Cockcroft-Walton accelerator. Thermal diffu-

sion parameters, $\Sigma_a v$, D and C , related to the decay constant of a system by the expression:

$$\alpha = \Sigma_a v + DB^2 - CB^4$$

when: $\Sigma_a v$ = Product of macroscopic thermal absorption cross-section for neutrons and their velocity

D = Thermal neutron diffusion coefficient

C = Diffusion Cooling Coefficient.

are determined by a polynomial least squares fitting of points on an α vs B^2 curve. Paraffin was selected because it has good neutron moderating properties and is easily formed into various shapes. Earlier studies (McClue and Robeson, Va. Academy of Science Annual Meeting, May, 1962) using water and ice have shown that while B^2 depends only on the dimensions of the sample the shape is quite significant. Measurement of decay constants for peculiar shapes having similar bucklings but differing surface to volume ratios is underway. The calculated buckling of several unusual shapes such as an oblate, ellipsoidal cylinder is available and an experimental check on the calculation is suggested by measuring α and then determining B^2 from a graph of α vs B^2 made for regular shapes (spheres, cylinders and rectangular parallelepipeds). Several modifications made in the experimental arrangements to improve neutron yield and reduce background are described but only preliminary data taken on regular paraffin shapes presented.

MEASUREMENT OF MOLECULAR WEIGHT DISTRIBUTION OF HIGH POLYMER

Hyo-gun Kim, *University of Virginia*

11. A solution of the ultracentrifuge diffusion equation has been transformed into a simpler expression as a function of the molecular weight distribution function $f(M)$. It was found that any symmetric form for $f(M)$ is not a proper one for ultracentrifuge experiment since concentration redistribution at equilibrium is not affected by the standard deviation of a Gaussian function. A Γ -function is assumed with 2 experimental adjustable parameters p and h . Deviation of $1/h$ from zero gives the spread of the distribution which has its maximum at $M = M_w$. The Burrough 205 computer at the University of Virginia calculates parameters p and h which fit the experimentally obtained concentration redistribution curve. Moment equations, then, are used as criterions for this distribution function.

Experiments should be performed at the H temperature since non-ideality of polymer solutions becomes serious at other temperatures. For a double-peaked distribution, the sum of 2 different Γ -distributions is used.

MAGNETORESISTANCE IN ZINC SINGLE CRYSTALS

Acar Isin and R. V. Coleman, *University of Virginia*

32. Anisotropy in the transverse magnetoresistance of zinc crystals has been investigated in a series of fourteen oriented crystals in order to obtain information on the topology of the Fermi surface. Samples with axes along the a-axis, c-axis, 1010-axis, and other selected directions have been used. Measurements were made at 4.2°K in a field of 13,500 gauss. Both high maxima and deep minima in resistance have been observed in the rotation diagrams of resistance vs. magnetic field orientation. In addition, complicated substructure has been observed on the sides of the main peaks. Preliminary analysis has shown the data to be consistent with a Fermi surface supporting open orbits along the c-axis and the a-axis direction. The substructure can be accounted for by considering the topology of the twelve arms of the Fermi surface in the second Brillouin zone. Careful analysis is presently under way, which we hope will enable us to make definite conclusions about the Fermi surface topology in zinc.

EXPERIMENTS ON THE EQUILIBRATION OF COPPER SURFACES

E. E. Laufer and J. W. Mitchell, *University of Virginia*

28. Smooth electrolytically polished surfaces remain smooth, apart from grain boundary grooving, when annealed in copper vapour, in inert gases or in hydrogen at temperatures near the melting point. Thermal facets are developed when crystals are annealed in inert gases containing low partial pressures of oxygen. This method of equilibrating surfaces has the serious disadvantages that the copper becomes saturated with cuprous oxide during the process. A fraction of the cuprous oxide separates as precipitate particles associated with dislocation loops during cooling. We have now found that similar thermal facetting develops when copper crystals are annealed at 900-950°C in argon containing low partial pressures of CF_4 , C Cl F_3 , and C Br F_3 . These molecules appear to be strongly absorbed on (111) surfaces of copper single crystals. They also do not react chemically with these surfaces. This new method allows crystallographically defined (111) surfaces to be produced on oriented slabs cut from mold-grown single crystals of copper. The annealing process appears to cause no modification in the bulk properties of the crystals. Such modification appears inevitably to be associated with the annealing of crystals in oxygen. The surfaces produced in this way can be used for experimental work on the generation of dislocations at surfaces and for other work on surface properties.

PROBABILITY OF RADIATIVE COLLISIONS OF ELECTRONS IN DIFFERENT TARGET MATERIALS

Maurice C. McGee and Jag J. Singh, *College of William and Mary*

13. The object of this experiment is to study the bremsstrahlung spectra created when electrons of energies in the range of 550 Kev up to 1000 Kev hit various target materials. The elements to be used in this experiment are Carbon, Silicon, Germanium, and Lanthanum. These elements have been chosen for two reasons: first, wide spread of their atomic numbers covers the entire periodic table and second, the Instrument Research Division of the National Aeronautics and Space Administration which is financing the research has particular interest in these elements.

The investigation will comprise studying the pulse height distribution of radiation, measuring its angular distribution, and calculating the total radiation cross-section.

The results will be compared with theoretical values calculated by using formulas given in Bremsstrahlung Cross-Section Formulas and Related Data by H. W. Kock and J. W. Motz, [Rev. Mod. Uphys. Vol. 31, 920 (1959)].

PROBABILITY OF RADATIVE COLLISIONS OF ELECTRONS IN DIFFERENT TARGET MATERIALS

Maurice C. McGee, Louis A. Galloway, and J. J. Singh
College of William and Mary

13.a The status of Bremsstrahlung theories in the range of electron energies of the order of mc^2 is not fully established. Perhaps the most successful predictions of radiative probabilities per atom are those of Bethe and Heitler [Proceedings of the Royal Society (London) A 146,83 (1934)] who used Dirac's equations for electrons and the Born approximation for treating the interaction of the electron with the nucleus. Both these assumptions are open to objection in the energy range of interest to us. We are planning an extensive program of Bremsstrahlung determinations in the energy range 100-1200 kev for target nuclei ranging from hydrogen to gold. The results of these measurements will enable an empirical correction to be made to the appropriate Born approximation cross sections. The results of these measurements will be presented.

RECOIL PARTICLES FROM DEUTRON REACTIONS

Charles D. Porterfield, *University of Virginia*

15. Semiconductor detectors are being used to detect recoil nuclei for d-n

reactions. The $B^{11}(d,n)C^{12}$ reaction has been chosen because of its high Q value and the well spaced energy levels of the C^{12} nucleus.

Detectors with thin windows are necessary. The fact that dE/dx is relatively large for recoil nuclei is used to distinguish them from elastically scattered deuterons of the same energy. The depletion depth of the detector is adjusted to a value between the range of the recoil nuclei and the elastically scattered deuterons. Suitable detectors are being fabricated. Pictures of several of these detectors are shown.

In order to minimize its input capacitance a preamplifier has been built that can be mounted in the scattering chamber. (R. L. Chase, W. A. Higinbotham and G. L. Miller, I.R.E. Trans. on Nu. Sci. NS-8, No. 1, p. 147, Jan. 1961.) Quantitative characteristics of this preamplifier are presented.

MICROWAVE CAVITY MEASUREMENTS OF THE FARADAY EFFECT IN A MAGNETIZED GASEOUS PLASMA

Maurice T. Raiford, *College of William and Mary*

1. Experimental investigations of the microwave Faraday Effect in a gaseous plasma using propagating waves have been described by previous authors. [L. Goldstein, *Advances in Electronics and Electron Physics* VII, 483. Academic Press, New York (1955).] We have made analogous measurements using cavity techniques at frequencies around 2000 Mc/sec. using a bi-modal cavity in the TE_{111} mode. Cyclotron resonance effects will be described.

A STUDY OF THE NUCLEAR QUADRUPOLE RESONANCE SPECTRUM OF BERYLLIUM IN CHRYSOBERYL

H. L. Reaves and T. E. Gilmer, Jr., *Virginia Polytechnic Institute*

26. The quadrupole coupling constant, the asymmetry parameter, and the orientation of the principal axes of the electric field gradient tensor with respect to the crystal abc axes were determined for the beryllium sites in chrysoberyl by the Volkoff method of rotation analysis. These values were found to be as follows:

$$\eta = .90 \pm .01 \text{ and } \left| \frac{e^2qQ}{h} \right| = 318 \pm 2 \text{ kc.}$$

The rotation about the c axis showed two pairs of satellites of nearly equal strength which indicated two different types of sites which were found to be equivalent. The principal axes at the two sites that correspond to the smallest eigenvalue of the diagonalized tensor (15 ± 2 kc) were found to

be parallel to the c axis. The axes that correspond to the largest eigenvalue of $(318 \pm 2 \text{ kc})$ lie 8.5 ± 1 degree on either side of the a axis in the ab plane. The axes that correspond to the intermediate eigenvalue $(303 \pm 2 \text{ kc})$ lie 8.5 ± 1 degree on either side of the b axis in the ab plane.

TELEMETERING FROM ROTORS

Thomas K. Robinson, *University of Virginia*

9. The temperature of an ultracentrifuge rotor suspended magnetically in a high vacuum can be measured accurately by means of a telemetering device incorporating a block oscillator, a multivibrator switch, and a tunnel diode oscillator, all housed within the rotor. Power may be supplied internally by mercury cells or induced into the rotor from an external AC source. Potential differences generated within centrifuged solutions may also be measured by applying them to a voltage-variable capacitor to frequency-modulate an oscillator contained in the rotor. These devices are contained in a cavity within the rotor two inches in diameter and one inch high. The former has been tested at rotor speeds in excess of 300 revolutions per second, while the upper limit of the latter appears to be somewhat more than 100 revolutions per second.

MICROPHOTOMETER

R. D. Rose and R. M. Elton, *University of Virginia*

8. A modified double photomultiplier, Michigan Type Microphotometer has been constructed at the University of Virginia to determine, with high precision, the distance between interference fringes as developed in molecular weight measurements in the Beams Type Equilibrium Ultracentrifuge. A spectroscopic plate with the fringe pattern is moved at known speed through a narrow beam of light. As the fringes pass through the beam, they alternately cut off and permit passage of the light to a measuring photomultiplier. This output is instantaneously relayed to a Varian Model G-10 recorder where the pattern is portrayed graphically. The distances between high peaks (destructive maxima) on the graph can be read to a precision of $1/128$ inch. Comparison with values of fringe separation as measured with a Mann Instrument Company Comparator have revealed that results using the microphotometer repeat to less than ± 10 microns, whereas results from the comparator repeat to less than ± 20 microns. This increase in precision further decreases the error in extrapolation for total fringe number, and subsequently the error in weight average molecular weight determination.

INVESTIGATION OF PYROLITIC GRAPHITE FOR EMITTER MATERIAL IN A THERMIONIC CONVERTER

William W. Scott, III, *University of Virginia*

21. Pyrolitic graphite was investigated as a thermionic emitter material for direct conversion of energy from a nuclear reactor to direct current electricity. Theoretical saturated current density is determined by the Richardson-Dushman equation and output voltage is predicted by potential energy diagram. Space charge effects are neutralized by ionized cesium plasma. A resonance mode thermionic diode incorporating enriched uranium carbide micro-spheres fission heat source, pyrolitic graphite emitter, stainless steel collector, cesium ion space charge neutralizer, thermal instrumentation, and plasma pressurizing system was designed and constructed. The converter was operated in the 10^{13} neutrons per square cm per sec. flux of the University of Virginia Reactor.

A VERSATILE, INEXPENSIVE 35MM PHOTOGRAPHIC SYSTEM FOR PHOTOMICROGRAPHY, COPYING, AND LANTERN SLIDE PRODUCTION

Richard T. Spencer and J. Thomas Ratchford,
Washington and Lee University

7. A versatile, inexpensive system of photographic equipment adequate for most needs of an undergraduate physics department has been assembled. The system consists of a 35 mm single-lens reflex camera with an f 2.8 lens, a copy stand with lights and timer, an extension ring set, an extension bellows, a microscope adapter, a tripod, and a sleeve for mounting the camera on the microscope. All components of the system are standard items readily available, with the exception of the microscope sleeve, which can be machined easily. The total cost of the equipment is approximately \$225.

The system may be used for photographing equipment set-ups, recording data such as diffraction patterns, for astronomical photography, for photomicrography, and for copying. [Supported by the National Science Foundation and the Robert E. Lee Research Fund.]

MEASUREMENT OF PARTIAL SPECIFIC VOLUMES

Dale V. Ulrich, *University of Virginia*

6. The magnetic balance is proving to be a useful tool for measuring the densities of liquids. While using only two-tenths of a milliliter of solution, densities have been measured to 0.0001 grams per milliliter. Partial specific

volumes of ribonuclease, tobacco mosaic virus, -keto-glutaryl dehydrogenase, and pyruvic dehydrogenase complex have been determined. It is desirable to know the densities of the solutions more accurately; so steps are now being taken to increase the sensitivity of the magnetic balance. This improvement can be achieved by making the density of the buoy closer to the density of the liquid.

A SURVEY OF (d,n) REACTIONS

L. van der Zwan, *University of Virginia*

14. A conventional [G. C. Neilson, W. K. Dawson, and F. A. Johnson, *Rev. Sci. Instr.* 30, 963 (1959).] neutron time of flight scheme is presented. The neutron detector consists of a R. C. A. 7046 14 stage photomultiplier with a 3" x 3" liquid scintillator NE213. An R. C. A. 6810A coupled to 1½" x 4" cylindrical plastic scintillator NE102 is used as the gamma detector. The transistorized time to amplitude converter [P. C. Simms, *Rev. Sci. Instr.* 32, 894 (1961).] has an electronic time resolution of approximately 3×10^{-11} secs. The over-all time resolution using side channels for energy selection is less than 2×10^{-9} secs. Examples of spectra for the reactions Be^9 (d, n) B^{10} , B^{11} (d, n) C^{12} , and C^{13} (d, n) N^{14} at deuteron incident energy at 1 mev are shown.

ANGULAR AND ENERGY DISTRIBUTIONS OF PHOTOPROTONS FROM C^{12}

H. D. Warren, *University of Virginia*

16. The angular and energy distributions of photoprotons from C^{12} have been measured from 6.75 to 21 Mev proton energies with a dE/dx , E coincidence-counting spectrometer and with 65 Mev maximum gamma-ray energy. Protons from 13.5, 21.3, and 39.1 $\text{mg/cm}^2 \text{CH}_2$ targets were counted at five angles for the 13.5 mg/cm^2 target and the low proton energies, and at seven angles for the other two targets and the higher proton energies. The average of the counting statistics was 6%. Analysis of the data indicates necessity of a $\cos \theta$ term in the angular distribution of the form $\sum a_i \cos^i \theta$. The energy spectra show no pronounced resonances at any angle, but they do show the existence of a small resonance at 13 Mev proton energy. These results are in general agreement with results from (e,e'p) experiments [V. J. Vanhuyse and W. C. Barber, *Nuclear Physics*, 26, 233 (1961)]. (Work supported by the U. S. Atomic Energy Commission).

MEASUREMENT OF MOLECULAR WEIGHTS OF VIRUSES

Fraustin N. Weber, *University of Virginia*

10. Utilizing the inherent stability of the magnetic suspension, the magnetic suspended ultracentrifuge (M.S.U.C.) has now been applied to the study of molecular weights (M) of virus particles. Several kinds of polyhedral plant viruses were kindly provided by Dr. R. Steere of the United States Department of Agriculture and their weights were ascertained using the rigorous sedimentation equilibrium method. Some of the values obtained thus far are: Southern Bean Mosaic Virus, $M=6.24 \times 10^6$; Bushy Stunt Virus, $M=6.99 \times 10^6$. Turnip Yellow Mosaic Virus, $M=5.20 \times 10^6$; Tobacco Ringspot Virus, $M=5.10 \times 10^6$. The very well characterized plant virus, Tobacco Mosaic Virus, (T.M.V.) was analyzed by the sedimentation equilibrium method. The molecular weight for T.M.V. determined was 40.45×10^6 . This value is probably accurate to better than $\pm 2\%$ and as such should be the most accurate measurement of M yet obtained for T.M.V. Some virus particles are too heavy to be conveniently run in the equilibrium centrifuge and have, therefore, been studied by a gravity cell. Here the sedimentating force is gravitational only. M has been found for Tipular Iridescent Virus; $M=(1.05 \pm 0.2) \times 10^8$; and for T₂ Phage, $M=1.97 \times 10^8$.

SECTION OF BIOLOGY

W. S. Flory Jr., *Chairman*W. West, *Secretary*J. Thompson, *Section Editor*I. Lewis, *Historian*

MINUTES

The annual business meeting of the Biology Section was called to order at 3 P.M., May 3, 1963 by the Chairman, Walter S. Flory, Jr. The report of the nominating committee was presented by Robert Brumfield, and the following offices were elected for the coming year: Franklin F. Flint, *Chairman*; Carolyn Wells, *Secretary*; and William S. Woolcott, *Representative to the Council*. Jesse C. Thompson is to continue as *Section Editor*.

Warwick R. West, Jr., *Section Secretary*

PLANTS OF THE MASSANUTTEN MOUNTAINS THAT ARE NOT
ABUNDANT IN THAT AREALena Artz, *Waterlick, Virginia*

5. Like many other parts of the Appalachian Mountain System, the Massanutten Mountains in Virginia are interesting botanically because plants are found here whose ranges are chiefly northern; or southern; or coastal plain. Here occur, too, plants of ancient genera whose relatives are found only in eastern Asia.

A SELF OPERATED CAMERA FOR RECORDING WILD TURKEY
ABUNDANCE AND DISTRIBUTIONJoseph P. Bachant, *Virginia Polytechnic Institute*

2. In 1962, the Virginia Cooperative Wildlife Research Unit initiated a research program designed to measure the effects of various systems of forest-wildlife management on wild turkey distribution and abundance. The first problem encountered was finding a census method that allowed one investigator to adequately sample the 11,000-acre study area since standard techniques were impractical. During the search for a new census technique, the use of automatic cameras for recording wild turkey abundance and distribution looked promising. A self-operating camera unit was developed that employed a simple box camera, the shutter of which was powered by a mouse trap. A monofilament trip wire over a bait line was used to spring the trap. Each bait line had two cameras in tandem with the trip wire. The wide angle camera was set to record the number in the turkey flock, the second camera gave a close-up picture of individuals which had been previously captured and marked with distinctive leg bands. Interpretation of the bands gave distribution data. The results obtained were promising. With a few minor refinements, more precise data may result in future trials.

THE GENETICS OF MOTTLING AND MICROPHTHALMIA IN THE
SYRIAN HAMSTERM. B. Berman and R. D. Hughes, *Medical College of Virginia*

32. Previously undescribed hamster mutants with mottled pelage and reduced eyes were obtained from a fancier's colony. Crosses were made to determine if mottling and microphthalmia are expressions of the same gene, and what the relation of this complex is to anophthalmia. The microphthalmic gene, tentatively designated *M*, appears to act as a partial dominant in producing the mottled pelage. Homozygotes are more

mottled than heterozygotes and have reduced eyes. The expression of the *M* gene in both heterozygotes and homozygotes is discussed. Crosses between microphthalmics (*MM*) and anophthalmic whites (*Wh Wh*) indicate that *M* and *Wh* are not allelic. The possible interspecific homologies of *M* and *Wh* in hamsters with *Mi^{wh}* and *mi* in mice are considered.

ASSAYS OF ALPHA-AMYLASE IN EMBRYOS OF THE OYSTER AND THE SEA URCHIN

Robert E. Black and E. T. Pengelley, *College of William and Mary*

33. Assays for alpha-amylase were performed on homogenates made at several pre-larval and larval stages of the oyster, *Crassostrea virginica* and the sea urchin, *Strongylocentrotus purpuratus*. Embryo homogenates were incubated in starch solutions, and the extent of hydrolysis was measured colorimetrically using 3, 5-dinitrosalicylate. In the oyster no enzyme was present until the early veliger stage (17 hours after fertilization at 28° C). Between 17 and 37 hours, it increased in nearly linear fashion, after which it showed a sharp decrease in activity. The rise in amylase activity occurred simultaneously with the development of the endoderm from a mass of cells into a three-chambered, ciliated larval intestine. The larval enzyme resembled amylase from the crystalline style of the adult rates of digestion of different starches and glycogen. In the sea urchin, embryos, no trace of amylase was found at any storage of development up to the 3-day pluteus larval stage, even though assays were performed at several pHs and with the use of several substrates. This undoubtedly indicates a difference in the nutritional requirements of the two kinds of larvae.

INTESTINAL HELMINTHS OF THE GROUND SKINK (*Lygosoma laterale*)

Garnett R. Brooks, Jr., *College of William and Mary*

34. The digestive tracts of 269 adult ground skinks collected over a two year period in central Florida were examined for intestinal helminths. Fifty three per cent were infected with a tapeworm, *Cyclotaenia americana*; 28 per cent with a fluke, *Mesocoelium* sp. (tentatively identified as *M. americanum*); and 51 per cent contained nematodes of two species, *Thubunaea* sp. (tentatively identified as *T. leiolopismae*), and *Physaloptera* sp. (tentatively identified as *P. squamatae*). Two skinks contained an unidentified acanthocephalan. Eighty-eight per cent of the adults had at least one species of parasite. Many skinks had two or more species of worms.

VEGETATION AND SMALL MAMMAL POPULATIONS OF NATURAL
AND DISTURBED PIEDMONT FORESTSDorothy L. Crandall and J. L. Chamberlain, *Randolph-Macon Woman's College*

18. The purpose of the study was to determine the influence of a drastic forest management practice on indigenous vegetation and associated small mammals. Field work extended from June, 1961 to September, 1962 on three mature forest types of the Lee Experimental Forest (Buckingham County) and four disturbed areas in Buckingham and Appomattox Counties. The disturbed areas were of different ages. The canopy, understory, shrubs and woody vines, and ground vegetation were sampled. Number, frequency, dbh, and line coverage data were obtained. Small mammals were live-trapped on a 5-acre grid. One hundred traps were placed 15 meters apart and exposed for a minimum of five consecutive nights. Disturbance of the forest area greatly increases the numbers of *Peromyscus* but does not alter the kinds of mammals present. Mouse populations seem to be directly related to the density of ground vegetation. The highest *Peromyscus* population was found on the youngest of the disturbed areas.

A REVISION OF THE NEOTROPICAL GENUS *ERILOPHODES* WARREN
(Lepidoptera; Geometridae)Charles V. Covell, Jr., *Virginia Polytechnic Institute*

3. The genus *Erilophodes* Warren (1894) is redefined, and the type species, *E. colorata*, is redescribed and illustrated. *Erilophodes spinosa* and *E. toddi* are new species described on the basis of male characters of the hind tibiae, abdominal spines, and genitalia. *Ischnopterix wagneri* Le Moults is considered to be a junior subjective synonym of *E. colorata*. Lectotypes for *E. colorata* and *I. wagneri* are selected. *Erilophodes indistincta* Warren is transferred to the genus *Ischnopteris* Hubner. *Erilophodes mamorinata* Bastelberger is considered a junior subjective synonym of *Neodesmodes semialbata* Warren. *Erilophodes arana* (Dognin) is transferred to the genus *Neodesmodes* Warren. All three species of *Erilophodes* are known from Brazil; *E. colorata* is also known from Argentina and Paraguay. No life history information is available. A key to the males of the species of *Erilophodes* is included.

THE ACUTE TOXICITY OF MOLYBDENUM TO THE BLUEGILL

Richard L. Easterday and Russell F. Miller, *Virginia Polytechnic Institute*

48. The ninety-six hour TL_m value for molybdenum as sodium molyb-

date to the bluegill (*Lepomis macrochirus*) was determined as 1320 ppm molybdenum in ion free water. Using Blacksburg, Virginia tap water, the toxicity of 1400 ppm molybdenum was decreased. Exposure of fish to 1400 ppm molybdenum supplemented with 3000 ppm sulfate or 0.125 ppm copper did not appear to effect molybdenum lethality. Gross examination of molybdenum-treated fish showed hemorrhages (intramuscularly, in the iris of the eye, along the dorsal fin, and the pectoral fins), and blue stomachs; histologic examination showed thrombi present in vessels of the kidney, spleen, gut, and meninges.

A NEW SUBGENUS IN *Luzula* (Juncaceae)

John E. Ebinger, *Roanoke College*

20. The species *Luzula purpurea* (Masson ex Buch) Link in Buch is examined taxonomically and it was found that the name *L. purpurea* is invalid and should be replaced by *L. elegans* Lowe. Morphological, anatomical and cytological comparisons are also made between this species and the remainder of the genus *Luzula*. These observations indicate that this species should be placed in a separate subgenus. The major distinctions between this species and the remainder of the genus which serve to distinguish this new subgenus are: (1) annual habit, (2) main axis of the inflorescence a pseudorachis, (3) seeds with extensive mucilaginous envelope, (4) a diploid chromosome number of six, (5) cells of the endodermis thickened evenly on radial and both tangential walls, (6) large epidermal cells without wavy walls, and (7) no mechanical tissue in the leaf margins. Due to these differences, the species *Luzula elegans* Lowe is placed in the new subgenus *Marlenia* subgen. nov.

A LABORATORY DEVICE FOR ACCELERATING PHOTOSYNTHESIS IN ELODEA

James F. Ferry, *Madison College*

31. This device consists of a reflector 22 inches in diameter and 10 inches in depth. Four 200 watt tungsten filament lamps are mounted 8 inches apart on the reflector and controlled by a multiple or single switch. Collectively the four lamps produce about 800 foot-candles with a spectrum ranging from 400 m μ to 700 m μ . A thin-glass container is placed 8 inches from the lamps and filled preferably with pond water. Either tapwater free of excessive air bubbles or cool water from a large carboy enters slowly into the bottom of the container and is siphoned off at the top to keep the water temperature below 27° C, since the evolution of O₂ bubbles is rapidly retarded above this temperature, presumably due to decreased enzymatic activity. The conventional Elodea-funnel setup is submerged but slightly elevated to facilitate circulation. If the collecting tube is small bore at the upper third, enough O₂ is trapped in two

hours to give a test. By manipulating the lamps and the water temperature, the effects of light intensity and/or temperature on photosynthesis can be roughly demonstrated.

ON THE OZARK CRAWFISHES COLLECTED BY PERRY C. HOLT IN THE
SUMMER OF 1961

J. F. Fitzpatrick, Jr., *University of Virginia*

9. The results of a five-day collecting trip by Perry C. Holt in the Ozark Mountain Region of southern Missouri were presented. One species in each of the crawfish genera *Cambarus* and *Procambarus* was collected; nine species of *Orconectes* were collected. Fifteen new county records were recorded, involving seven species of *Orconectes* and one species of *Cambarus*. The range of one species of *Orconectes* almost was doubled, and one new species of *Orconectes* belonging to the Hylas Group was discovered and described.

PRELIMINARY OBSERVATIONS ON GONADECTOMY IN CRAWFISHES

J. F. Fitzpatrick, Jr. and James N. Dent, *University of Virginia*

10. A surgical technique for gonadectomy in crawfishes is described. This technique permits the visualization of the gonad *in situ* during the operation in such a way that all or selected parts of it can be removed. Preliminary observations indicate that the histological features of the gonoducts are not controlled by the gonads in subadult crawfishes. (Supported in part by A. E. C. Contract #AT-(40-1)-2978, and in part by an institutional grant of the American Cancer Society.)

THE NUCLEOLUS OF *Lilium*

Franklin F. Flint, *Randolph-Macon Woman's College*

38. The megasporocytes of *Lilium michiganense* Farl. were used as material for this study with confirmatory observations on *L. pardalium* Kell. The nucleolus arises from pronucleolar substance(s) which coalesce to form a globular mass. There is visual evidence to support the belief of Estable and Sotello that there is a nucleonema and pars amorphous within the nucleolus. Certain extrusion bodies are followed from their inception within the nucleolus until their disappearance within the nucleoplasm.

THE GENUS *Buxus* AND RECENT EFFORTS TO BROADEN OUR KNOWLEDGE
OF ITWalter S. Flory, *The Blandy Experimental Farm*

45. Boxwood is probably the most important garden and nursery ornamental plant in Virginia, and is important in many other parts of this country. The genus *Buxus* is widely scattered through warmer regions of the world. It is a variable genus of disputed size, species-wise. Practically all *Buxus* cultivars are genetically heterozygous, with their seedling populations exhibiting types of great diversity. Because of the great interest and relatively narrow knowledge in and about Boxwood, The American Boxwood Society was organized — in 1961 — devoted to the advancement of knowledge concerning *Buxus*. With members from most states, the organization has headquarters at the Blandy Experimental Farm. It publishes a quarterly journal "The Boxwood Bulletin", the second volume of which has just been completed. The Bulletin publishes both scientific and popular articles dealing with any phase of Boxwood.

MINERAL REQUIREMENTS OF SELECTED SPECIES OF AQUATIC
HYPHOMYCETESD. W. Hickman and W. W. Scott, *Virginia Polytechnic Institute*

28. Four species of aquatic Hyphomycetes were selected on the basis of rapidity and reproductibility of growth. These were grown in liquid culture on a rotary shaker at constant temperature. The morphological responses and amounts of mycelium produced in media of different mineral compositions were determined. Glucose was the only organic constituent required. Macro-elements were varied from zero to concentrations in excess of those yielding maximum mycelial dry weight. It was found that variations in mineral concentrations can significantly alter the apparent morphology and physiology of these organisms. Therefore such investigations are prerequisite not only to a reliable taxonomic study of these species, but to examinations of their organic nutrition as well.

SOME OBSERVATIONS ON TISSUE AND CELL METABOLISM OF SMALL RODENT
POPULATIONSJune C. Hill and Ruth C. Mayhew, *Madison College*

6. Respiratory assays were made on three species of small wild rodents of a native population. These species were *Microtus pennsylvanicus*, the meadow mouse, *Peromyscus leucopus*, the deer mouse and *Mus musculus*, the house mouse. Q_{O_2} values for the succinoxidase systems of liver and

kidney and for liver tissue slices were determined by the Warburg method. Examination of the data revealed an inverse relationship between body size and specific enzyme activity on an interspecific basis, and for *Mus musculus* on an intraspecific basis. However, no such relationship was found to exist for tissue slice Q_{02} . Average monthly tissue Q_{02} values for *Mus musculus* exhibited rhythmic responses to seasonal variations. This correlation was not found to exist at the cellular level.

THE HELMINTHS OF OPOSSUMS IN WESTERN VIRGINIA

Harry L. Holloway, Jr. and Janet L. Dowler, *Roanoke College*

21. The examination of four opossums collected in Craig, Giles, and Roanoke Counties has revealed the presence of three species of intestinal helminths and one unidentified acanthocephala. The trematode, *Brachylaem virginiana*, was originally reported from Albermarle County by Dickerson (1930). According to the literature available this was the only opossum parasite previously known to occur in Virginia. Seven specimens of *B. virginiana* were recovered from two immature hosts trapped in Giles County. The specimens were removed from the small intestine. A total of eighty-two specimens of *Cruzia americana* were recovered from the four hosts examined. The number of worms per host ranged from 3 to 38, with an average of 20 worms per host. The metric analysis of thirty seven worms agrees with data given by Crites (1956) in a redescription of the species. However, the worms examined during this study differ in several respects from specimens analyzed by Byrd (1942). Fifteen specimens of *Physaloptera turgida* were recovered from the opossum collected in Craig County. The literature available does not permit metric comparisons. One immature female acanthocephala, showing incipient ovarian disintegration, was recovered from the host trapped in Roanoke County.

ECOTYPES IN *Goodyera pubescens* Willd

W. S. Hooks, *Randolph-Macon Woman's College*

40. Evidence gathered as a portion of study in the autecology of *Goodyera pubescens* Willd. indicates that there are morphological differences in populations of the species in widely separated habitats of varying structure. The morphological characteristics studied and compared with the standard taxonomic description were: leaf characteristics; diameter of foliar rosette; length of scape; raceme length; flowers per raceme. The data for the study was obtained from the study of approximately fifteen thousand field specimens and two thousand herbarium specimens. The study was conducted chiefly along the western margin of the range. This included study areas from northern Illinois to northwestern South Carolina.

Data obtained from the studies thus far completed indicate that there is variation within *G. pubescens* and at the present time it appears possible to describe at least three ecotypes within the species.

THE CHROMOSOMES OF T/21 MONGOLISM, T/21 MONGOLISM (*Mosaic*)
AND T/s5, T/s6. OR TL/16

Ladley Husted, *University of Virginia* and
Lyman R. Emmons, *Washington and Lee University*

46. The chromosomes of three normal males, a female with T/21 Mongolism, and a male with T/21 (*Mosaic*) Mongolism and trisomic for the short arm of chromosome 5, 6, or the long arm of 16, have been represented as idiograms separately, and then combined in part, and represented as an idiogram in which each autosome is the mean of 132-255 measurements, the X-chromosome the mean of 113, and the Y-chromosome of 71. The results of an attempt to distinguish the X-chromosome and each of the chromosomes in Group 6-12 are the same in the five individuals. The female with Mongolism differs from the normal males in three ways: (1) she is trisomic for chromosome 21; (2) chromosome pairs 6 and 7 are longer than the X-chromosomes; and (3) the centromeres of chromosome pair 2 are more medium in position. The boy with Mongolism is trisomic or multisomic for chromosome 21 in some, but not in all of the cells; chromosome pairs 6 and 7 are longer than the X-chromosome; and the centromeres of chromosome pair 2 are more median in position. He differs from all of the others by being trisomic for the short arm of chromosome 5 or 6, or the long arm of 16, and by having a longer chromosome pair 1. The idiograms of these two are so similar that they suggest the possibility that an additional 21 influences the behavior of chromosomes 2, 6 and 7. An additional arm of chromosome 5, 6, or 16 may influence the behavior of chromosome pair 1.

X-IRRADIATION EFFECTS ON A PARTHENOGENETIC SPECIES OF ANOETID
(*Acarina*)

Caroline Goode Jackson and R. D. Hughes, *Medical College of Virginia*

43. Preliminary investigations were conducted employing a range of selected irradiation doses on developmental stages of an anoetid mite. Within the diploid parthenogenetic variety of *Histiostoma feroniarum*, the larval stage was found to be most radiosensitive. A large number of preimagal deaths, presumably due to molting difficulties or malformations, were noted. Of the treated larvae which successfully completed three (3) molts to adult, gross malformations, such as missing or stunted legs, were observed where treatment was as low as 250r. Other responses to irradiation

tion were reduced egg productivity and egg lethality. Effects to leg anlagen and hyodermal cells are produced; however, it is considered that somatic effects are not limited to the formation of cuticle. That lowered egg productivity and egg lethality are due in part to somatic damage is a possibility deserving further investigation.

BETA-ALANINE UTILIZATION IN EBONY AND NON-EBONY *Drosophila melanogaster*

M. E. Jacobs and K. K. Brubaker, *Eastern Mennonite College*

7. Carbon-14-Labeled beta-alanine was injected into newly formed *Drosophila melanogaster* female pupae. Homozygous ebony deposited less C^{14} in pupal sheaths, deposited more C^{14} in adult body extracts and wings, and decarboxylated an oxidized beta-alanine to excrete $C^{14}O_2$ faster than did non-ebony homozygotes. Heterozygotes were intermediate in all these activities. The relationships of beta-alanine, beta-amino-isobutyric acid, and gamma-amino-butyric acid, and gamma-amino-butyric acid metabolism as well as the effects of these substances on nervous transmission in vertebrates and invertebrates, and polymorphism of genetic system controlling such metabolism was discussed.

NOTES ON OKLAHOMA PLANARIANS

Marie M. Jenkins, *Madison College*

8. *Dugesia dorotocephala*, planarians inhabiting constant temperature springs in Oklahoma, have been shown to be sexual during all months of the year. Laboratory-reared adults (500) and cocoons (50) of this species were transferred to Virginia in August, 1962, and installed in an air-conditioned laboratory. Thirty-three of the adults survived the trip. Cocoon production was not re-established until November. Only 29% of the cocoons produced in Virginia have been viable, compared with 91% in Oklahoma. Most of the emerging young died. From the cocoons transferred, 717 juveniles emerged, and 285 survived. At six months of age, only 45% were sexual, compared with over 99% in Oklahoma. During the eighth month, cocoon production averaged 0.05 cocoons/worm/month, compared with 0.28 for planarians of the same age in Oklahoma. Supernumerary gonopores, ranging from two to six, have been observed in 29% of sexual planarians in Virginia. None were observed in Oklahoma. Fission products constitute 15% of the present population, compared with 0.1% for a similar group in Oklahoma. Water from lakes and streams, as well as prepared solutions, have been used, but none have proved satisfactory. For normal sexuality in planarians, it appears the chemical constitution of the water may be a factor of prime importance.

POPULATION ECOLOGY OF THE TREE FROG, (*Cochranella fleischmanni*)Duvall A. Jones, *Ferrum Junior College*

11. A population of centrolenid frogs of the species *Cochranella fleischmanni* was studied over a nine day period on Barro Colorado Island in the Panama Canal Zone. The general habitat may be characterized as a lowland tropical rain forest. Most of the observations were made on a plot of second growth forest, through which a stream meandered. *C. fleischmanni* was rarely found more than three feet from the stream in horizontal direction, although individuals were seen calling more than sixteen feet above the stream. Males called from a restricted area of leaves or leaflets. Females evidently moved toward the males in response to the vocal stimulus. Amplexus and deposition of eggs took place on the underside of leaves above the stream. Male frogs were often found in the vicinity of the embryos during their development. As many as four egg masses were noted within sixteen inches of calling males, thus indicating multiple matings. About two weeks after egg deposition, tadpoles had reached ten millimeters in length, hatched and fallen into the stream below. Twenty-one males were associated with twenty-eight complete egg masses (average: 27.5 embryos per mass) and fifteen others. Mortality rate to hatching was 1.1%. Population density of calling males was 97.6 per acre.

THE INFLUENCE OF LIGHT ON THE GROWTH AND REPRODUCTION OF
Saprolegnia parasitica COKERPhilip C. Lee, Jr., *Virginia Polytechnic Institute*

24. Pure cultures of *S. parasitica* Coker were grown under varied light conditons. Cultures grown in continuous artificial light produced double the number of sporangia compared with colonies grown in complete darkness. The average diameters of the colonies grown in complete darkness were 25% less than the average diameters of colonies grown in constant light. When cultures were grown in various series of alternating light and darkness, those that received the greatest total illumination produced the greatest numbers of zoosporangia.

Botrychium alabamense, MAXON AND *B. matricariifolium*, A.BR. IN
VIRGINIAA. B. Massey, *Virginia Polytechnic Institute*

4. The Alabama grape fern, *Botrychium Alabamense*, was discovered in Alabama in 1906 and described by W. R. Maxon. It has not been known

to occur north of North Carolina. Recently it has been found in Wise County, Virginia, thus extending the northward range some 150 miles. This adds another species to Virginia's Flora and Gray's Manual of Botany since the latter does not consider species known only south of Virginia. *Botrychium matricariaefolium* the daisy leaf grape fern, is a northern species first recorded in Virginia in Rockingham Co. in 1941. More recently recorded in Page, Fauquier, and Accomac Counties. In the summer of 1962 Dr. Warren Wagner, conducted a class in Pteridology at the Mountain Lake Biological Station. The species was discovered in Grayson and Giles Counties. Thus recording the species in six Virginia counties. With the exception of Accomac County all of the Virginia records are in the upland counties.

PROTEIN UPTAKE IN PLANARIANS

Paul J. Osborne, *Lynchburg College* and

A. T. Miller, Jr., *University of North Carolina*

47. The Benzidine color reaction product (bright blue) of horseradish peroxidase makes it an excellent marker or indicator of its own uptake after having been introduced into the bloodstream of vertebrates. In rats it is readily taken up by the kidneys after filtration and reabsorption in the form of small phagosomes. Slices of such rat kidneys were fed to planarians to see if they in turn could take up the enzyme, second hand, from the intermediate source, and if so this would be a portion whose fate could then be traced in the flatworm. Following a delay of one day to permit complete phagocytosis the worms were fixed in formal-calcium at hourly then daily intervals through ten days. They were sectioned in a cryostat and incubated in a benzidine-alcohol substrate. A well defined pattern of uptake was observed, occurring first in a diffuse form, then granular accumulations, next as droplets, and finally, from one day on as foodballs (phagosomes), in which form they remained until losing their color gradually until all were clear by the eighth day. A return to transparency was taken to be indicative of sufficient digestion to denature this protein, at least to the extent of inactivating it as an enzyme; at the same time showing the rate of protein digestion in the flatworms.

DIFFERENTIAL GROWTH EFFECTS OF LIVING AND DEAD MICRO-ORGANISMS ON VARIOUS SPECIES OF ANOETIDS (*Acarina*)

Justine M. Murphy and R. D. Hughes, *Medical College of Virginia*

42. Certain live microorganisms in pure culture can serve as the sole nutrient source for five species of anoetid mites. Not all mite species

tested can utilize the same bacteria as a food source, indicating that there is a distinct species specificity regarding nutritional requirements. Some bacteria, such as the Enterobacteriaceae, support growth of the mites at an apparent optimal rate. When other species, such as *S. aureus* and *S. rubrum*, are supplied to the mites as a nutritive source, growth and development are somewhat slower. Still other microorganisms, such as the spore forming rod, *B. subtilis*, and certain yeast species are not adequate as a nutrient source since death of the mites occurs in the larval stage. The nutrient properties of the bacteria are heat labile, non-filtrable and destroyed by ethylene oxide gas. Bacteria killed with ultraviolet and x-irradiation retain their nutritional value and support growth of the anoetids for many successive generations, indicating that the mites do not derive their nourishment from the products of bacterial metabolism.

AN ANALYSIS OF THE VIRGINIA AVIFAUNA

J. J. Murray, Sr., *The Virginia Society of Ornithology, Lexington*

16. Virginia has a well-authenticated bird list of 440 forms, 364 species and 76 additional subspecies. A breakdown of this list shows the following: extinct species, 3; residents, 85; summer residents, 118; winter residents, 75; transients, 104; accidentals, 55. There are, in addition, about 15 good hypothetical forms.

FOREST CUTTING AND ITS INFLUENCE ON BROWSE PRODUCTION

David R. Patton, *Virginia Polytechnic Institute*

1. A study to determine the response of food production in forest stands as influenced by different cutting intensities and time-since-cutting was conducted on the Broad Run Research Area, Jefferson National Forest, Craig County, Virginia. Browse or current annual growth of stems and twigs from woody plants was clipped on sample areas $\frac{1}{2}$ -acre in size in 11 cut and 4 uncut areas. Four plots, $\frac{1}{250}$ -acre in size, were clipped for each $\frac{1}{2}$ -acre area. Cutting intensity was expressed as a per cent of the basal area removed — basal area being the number of square feet per acre of trees over 4 inches and above measured at a height of 5 feet. Results indicated that the amount of browse produced on cut areas was related to the per cent of the stand removed and the number of years after cutting.

ASPECTS OF RADIOSENSITIVITY BASED ON WORK WITH *Pinus*

Robert A. Pedigo, *College of William and Mary*

35. Several aspects of the ecological effects of ionizing radiation on lob-

lolly pine (*Pinus taeda* L.) were studied between June, 1959 and November, 1960. Experiments were conducted at Emory University and in the field at Air Force Plant 67 where a partially shielded reactor provides a radiation field of several hundred acres. Results presented here are restricted to experiments conducted at Air Force Plant 67 and are primarily concerned with the general features of radiation damage and effects on growth. Discoloration, death of terminal buds, and inhibition of reproduction occur after exposures of 1,000 to 2,000 rads. Accumulation of greater doses results in complete browning, defoliation, and death. The lethal dose is about 7,500 rads. Terminal and radial growth exhibit a differential radiosensitivity, the former inhibited by about 1,000 rads and the latter requiring 3,000 to 4,000 rads for inhibition. In addition, terminal buds are differentially affected depending on whether or not they occur on terminal or lateral shoots. These relationships suggest a physiological basis for radiosensitivity based on auxin metabolism or factors correlated with auxin metabolism. In general, the results observed indicate that ionizing radiation of relatively low doses will greatly hinder the success of loblolly pine in its normal habitat.

MECHANISM OF GENE CONTROLLED RESISTANCE VS. SENSITIVITY TO
CALCIUM IN *Podospora anserina* NIESSL

James E. Perham, *Randolph-Macon Woman's College*, and
A. Gib Debusk, *Florida State University*

19. Resistance versus sensitivity to calcium ion is controlled by a single gene in *Podospora anserina* Niessl. This calcium sensitive locus, Ca*, is located 0.51 map units from the centromere. Microscopically, the calcium sensitive mutant gives the appearance of a colonial strain with a diameter of 4-10 mm. Microscopically, the cells composing the individual hyphae are found to be irregular in shape with diameters 10-20 times that of a normal hyphal cell. A four-day-old colony has a parenchymatous-like appearance with the cells at the edge of the mass having yeast-like buds. Preparations of mutant hyphae stained with Sudan black b clearly demonstrated the presence of large sudanophilic lipid globules within the cytoplasm which are not present in the wild-type strain. It is postulated that the influence of calcium is indirect and that the primary lesion in metabolism is the inability of the mutant to breakdown the accumulating lipid product.

ECOLOGICAL CHANGES IN AN OLD "CHESTNUT-OAK" FOREST

Alice V. Racer and W. S. Hooks, *Randolph-Macon Woman's College*

39. Russell Nature Preserve is part of the oak-chestnut forest associa-

tion. Qualitative and quantitative studies were made within the area for 1961-1963. After the chestnut blight showed its final effects there from 1918-1920, factors were present which created a zeric condition favorable to pine invasion. Instead, oak became dominant to the exclusion of pine because of the rapid growth of oak root shoots which had germinated from acorns of oaks co-dominant with chestnut. Because of unfavorable conditions, the tops of these root shoots had been destroyed year after year. When the canopy was opened after the chestnut blight, these oak root shoots grew rapidly and replaced the chestnut canopy. Oak root shoots now in the forest have slight above-ground growth, but roots ranging in age from 15 to over 30 years. Even-aged stands of oak species in definite circles around old chestnut stumps are correlated in age with the years of the chestnut blight. The new forest type was determined by the oak root shoots even while the old chestnut canopy existed.

THE HIGH SCHOOL CHALLENGE IN BIOLOGY

Vera B. Remsburg, *Herndon High School*

25. The BSCS course in biology is designed not necessarily to produce scientists, but rather to meet the needs of students, all of whom are living in a world of science and scientific policies. The purpose of the course is rather to use facts, ideas and concepts in the actual development of scientific investigations in the laboratory. The course makes learning an active undertaking; material is appropriate to the training of all youth; and materials are presented to contribute to the development of attitudes and skills as well as knowledge.

THE EFFECT OF ULTRA-VIOLET RADIATION ON THE VIABILITY OF TRANSPLANTED BONE MARROW CELLS

Nancy Tate Saprkes, *Randolph-Macon Woman's College*

41. The transplantation of ultra-violet treated isologous bone marrow cells into lethally irradiated mice was used, to produce mutation in the hemoglobin of radiation chimeras. Bone marrow cells from the femurs of male, LC3F₁ mice were suspended at a dilution allowing 10% absorbance at a wavelength of 2537 Å (slightly over 2×10^6 cells/ml). Half portions of these suspensions were exposed to ultra violet doses varying from 200-5000 ergs/mm² by a G. E. 15-watt germicidal lamp, in 24 ml. aliquots. The remaining portion was unexposed, and both the normal and irradiated cells were centrifuged, and rediluted at 20×10^6 /ml. 0.5 ml injections of this suspension were then injected intravenously into lethally irradiated (950 r of X-ray) 1C3F₁ recipient mice, which were

then examined for each day of the 30 days following irradiation and injection. The number of dead was recorded. A mortality of 98.6% occurred in those control animals receiving only 950 r of X-ray. Only 8% mortality was recorded in those mice receiving normal isologous bone marrow cells, after whole body irradiation. It was determined that ultra-violet doses in the 200-300 ergs/mm² range allowed 50% survival, and could be used for the production of mutations of the donor marrow of radiation chimeras.

STUDIES ON THE FUNGUS FLORA OF MARINE AND BRACKISH WATER IN THE VICINITY OF GLOUCESTER POINT, VIRGINIA

W. W. Scott, *Virginia Polytechnic Institute*

29. Studies concerning the occurrence and distribution of phycomycetous fungi from the York River system were presented. Species described were mostly members of the Chytridiales and Saprolegniales. Described as new were two species of *Rhizophydium*, one of which exhibited internal zoosporangial proliferation, and a species of *Podochytrium* parasitic on the diatom *Coscinodiscus asteromphalus*.

THE PURE CULTURE OF *Saprolegnia* spp. ON A CHEMICALLY DEFINED MEDIUM

W. W. Scott, J. R. Powell and R. L. Seymour, *Virginia Polytechnic Institute*

23. Eight species of *Saprolegnia* were established in pure culture on a chemically defined medium and produced antheridia, oogonia, and mature oospores. As far as we know this is the first report of sexual structures and the germination of oospores occurring in pure cultures of *Saprolegnia* on a synthetic medium. Preparation of the medium and culture techniques were described.

OBSERVATIONS ON THE GENUS *Isoachlya*

Roland L. Seymour and W. W. Scott, *Virginia Polytechnic Institute*

26. The only characteristic used to distinguish *Isoachlya* is far too variable to be of any valid taxonomical significance. It is proposed that *Isoachlya* be reduced to synonymy with *Saprolegnia* and the species formerly classified as *Isoachlya* be included at the present time as valid species of *Saprolegnia*.

A COMPARISON OF THE RESPONSES OF SOME SPECIES OF
FISHE TO THE TOXIC EFFECT OF *Lophopodella Carteri* (Hyatt)

Wilton R. Tenney and William S. Woolcott, *University of Richmond*

22. The body juice of *Lophopodella carteri*, a freshwater bryozoan, is toxic to fishes. Diluted extracts of crushed colonies were found to be lethal to nine species of fishes. There were indications that the species varied in susceptibility to the poison, and that concentration of the extracts was related to death times. *Micropterus salmoides* and *Lepomis macrochirus* were tested in an 8 percent extract and the difference between their mean death times was found to be statistically significant. White mice and frog tadpoles were unaffected by the poison, as were several invertebrates.

A PRELIMINARY INVESTIGATION OF COMPLEX INCIPIENT SPECIATION IN
Drosophila tropicalis

J. Ives Townsend, *Medical College of Virginia*

44. All possible intercrosses (54) have been attempted between geographic strains of *Drosophila tropicalis* from Cuba, Puerto Rico, Honduras, Panama, Venezuela, and the three Brazilian localities, Icana, Belem, and Palma. Results indicating complex incipient speciation were disclosed. At one extreme, the Cuban and Puerto Rican strains were fertile *inter se*, and their hybrids were completely fertile. At another extreme, females from Cuba, Puerto Rico, Honduras, Panama, and Icana produced viable progeny by Venezuelan males; yet Venezuelan females were inseminated by only their own kind of males. But females from the type locality, Palma, were inseminated and produced progeny by males from Puerto Rico, Icana, and Belem; yet Palma males were able to inseminate only their own kind of females. (Helga Winge, via personal communication, reports similar results with the Palma strain when tested with strains from Trinidad and Tefe, Brazil.) An intermediate condition was revealed by the Panamanian strain: its females produced viable progeny by males from Cuba, Puerto Rico, Honduras, Venezuela, and Belém; yet Panamanian males were able to inseminate, and produce viable progeny by, only Cuban and Puerto Rican females, in addition to their own. Other intermediate relationships were also disclosed. (Support by NSF Grant G-19445).

REPRODUCTION IN EAST NORTH AMERICA *Ruellia* L. (Acanthaceae): OBSERVATION AND TAXONOMIC IMPLICATIONSLeonard J. Uttal, *Madison Heights, Virginia*

12. *Ruellia* is taxonomically difficult because of few reliable differentiating characters and meager knowledge of reproduction. Though facultatively allogamous, *Ruellias* habitually self-pollinate cleistogamously or variously mechanically in open flowers. Cleistogamous infraspecific taxa are invalid. Populations are disjunct and comprise identical plants. Well-marked species of limited ecology are quite homogeneous. Other species of more diverse habitat vary much between populations resulting in taxonomic confusion. No genetic barriers appear between any species of eastern North America except *R. noctiflora* (*R. succulenta* not tested), however, wild hybrids are unknown. Genetic barriers appear to conform to the sections of the genus. Tests suggest capsule and calyx characteristics, pedunculation, petiolation, style length, inflorescence, period of flowering and seed size are more consistent characters than foliage nature and internode length. The latter have received undue stress. *Ruellia* appears to have been subjectively 'fractured'. Future monography should result in better drawn species and less varieties and forms.

LABORATORY STUDIES ON THE CONTROL OF FUNGUS INFECTIONS OF FISHES

Charles O. Warren and W. W. Scott, *Virginia Polytechnic Institute*

27. It has been shown by workers such Tiffany (1939), Vishniac and Negrelli (1957), and Scott and O'Bier (1962) that certain aquatic phycomycetous fungi have the ability to parasitize fish. As suggested by these workers, there is most probably a wide host range involved in this problem. Recent concern by tropical fish hatcheries has prompted experiments dealing with fungi associated with tropical fish. Species of *Pythium*, *Achlya*, and *Saprolegnia* have been isolated from various tropical fish. Further studies will be carried out to determine a general host range. Compounds such as malachite green, phenoxetol, and others will be tested as potential chemical controls for these fish parasites.

FROM CORAL REEF TO TROPICAL ISLAND VIA *Thalassia* AND MANGROVEBruce L. Welch, *College of William and Mary*

37. As a reef front advances the corals which previously occupied the reef front are sheltered and die. They are overgrown, consecutively, by filamentous-like algae which trap small particles of silt *Boodleopsis*, *Digenia*, *Sphacelaria*, *Jania*), by mat-forming calcareous algae (*Halimeda*

opuntia, *Amphiroa fragilissima*), and by the marine spermatophyte, *Thalassia testudinum*. Colonization by mangrove follows and may lead to the formation of land and, ultimately, to a terrestrial sere.

EFFECTS OF AGGREGATION AND OF SOCIAL RANK UPON THE CATECHOL AMINE CONTENT OF THE ADRENAL MEDULLA OF MICE

Bruce L. Welch, *College of William and Mary*

36. The adrenaline and noradrenaline content of the adrenal medulla of adult male albino mice which had been isolated for three weeks or which had been in groups of 2, 4, 8, 16, 20, or 32 for the same period of time, were determined fluorometrically by the trihydroxyindole method. The percent of total catechol amines which were present as adrenaline tended to increase as group size increased. This was due primarily to the greater content of noradrenaline in the adrenal medulla of mice from the smaller groups. The adrenals of socially dominant mice contained both more noradrenaline and more adrenaline than did the adrenals of social subordinates.

THE ORIGIN AND CHARACTERISTICS OF STRAIN EU 6010, (*Tetrahymena pyriformis*)

Carolyn Wells, *Longwood College*

30. Strain EU 6010, *Tetrahymena pyriformis*, is an exconjugant clone obtained from a conjugation cross between strains EU 6000 (variety 6, mating type I) and EU 6002 (variety 6, mating type III). EU 6010 has the following characteristics: an average of 20 ciliary meridians, a diploid micronucleus ($n=5$), a mean generation time of 3 hours and 15 minutes at 29° C in proteose-peptone liver-extract medium. It is a member of variety 6, mating type III. EU 6010 is identical to its parental strain EU 6002 in all of the preceding characteristics. Unlike EU 6002, EU 6010 will undergo selfing conjugation in distilled water, and will form triple associations if mixed with a population of homopolar doublet organisms in physiological salt solution. (Work supported by United States Atomic Energy Commission, Contract No. AT—(40-1)-2793).

SECTION OF CHEMISTRY

R. G. Steinhardt, *Chairman*R. J. Rowlett, Jr., *Secretary*C. C. Clayton, *Historian*M. A. Kise, *Section Editor*

MINUTES

Chairman R. G. Steinhardt, Jr. called the meeting to order at 11:43 A.M. Minutes of the 1962 business meeting were approved as published in the Journal for September 1962.

R. C. Krug, chairman of the Committee on Undergraduate Summer Employment, reported on the survey study of summer employment opportunities. About 20 organizations replied to his questionnaire but not four had specific summer programs. Others had informal plans which were almost always limited to the relatives of employees. He stated that a report of this survey had been sent to all four-year colleges in the State. The Committee recommended that no further action be taken until the reaction of the college chemistry department chairmen to this first survey can be learned. This was moved, seconded and approved. The Chairman expressed the Section's gratitude for the work of Dr. Krug's committee and suggested that the new officers evaluate any additional studies of this nature.

The Nominating Committee, Frank Vingiello chairman, recommended the following slate of new officers: *Chairman*, Russell J. Rowlett, Jr., Virginia Institute for Scientific Research; *Secretary*, John Daffin, Mary Baldwin College; *Counsellor*, William E. Trout, University of Richmond; *Section Editor*, G. R. Bass, Jr., Richmond Professional Institute.

The nominations were closed and the new officers were unanimously elected.

There was no new business and the meeting adjourned at 11:50 A. M.

Russell J. Rowlett, Jr., *Secretary*

A RECIPROCATING, HIGH RATE OF SHEAR, CAPILLARY
VISCOSIMETER

V. M. Barnes, Jr., N. E. Flournoy, and E. H. Rowe, *Texaco Experiment Incorporated, Richmond*

14. Viscosity was defined as it applies to gels. Methods of measurement were discussed with emphasis on the capillary tube approach.

The apparatus built at TEI was described and its operation explained. The range, calibration, test procedure, and calculations were briefly examined.

THE DETERMINATION, DISTRIBUTION AND METABOLISM OF DOXAPRAM
HYDROCHLORIDE (AHR-619)

Robert B. Bruce and Franklin M. Pinchbeck, *Research Laboratories,
A. H. Robins Co., Richmond*

25. An analytical method for doxapram, 1-ethyl-4-(2-morpholinoethyl)-3, 3-diphenyl-2-pyrrolidinone. $\text{HCl} \cdot \text{H}_2\text{O}$, in biological materials has been determined. The rate of excretion and distribution in dogs have been determined. Analysis of the urine by thin layer and paper chromatography indicate three metabolites with basic properties. One of these has been identified as 1-ethyl-4-(2-hydroxyethylaminoethyl)-3, 3-diphenyl-2-pyrrolidinone.

REACTIONS OF PHOSPHORUS ESTERS WITH AMINES

W. M. Byrd and R. T. Kemp, *Research Department, Virginia-Carolina
Cheical Corporation, Richmond*

21. Reactions of neutral phosphonates or phosphates with amines result in alkylation of the amines to produce ammonium salts of the monobasic phosphorus acids. These reactions are general for primary, secondary, and tertiary amines. Consequently uncontrolled reaction with repeated alkylation at the same nitrogen may take place resulting in a mixed product. The reaction occurs under mild conditions (room temperature), but it fails even at elevated temperatures when phosphorus esters with bulky alkyls are used. The reaction is self-limiting to monodealkylation of the phosphorus ester, affording a preparative method for monobasic acid phosphonates and phosphates.

THIN LAYER CHROMATOGRAPHY OF AROMATIC NITRO AND AMINO COM-
POUNDS

Mary D. Christian, Sam Rose, and H. deSchmertizing, *Melpar, Inc.,
Falls Church*

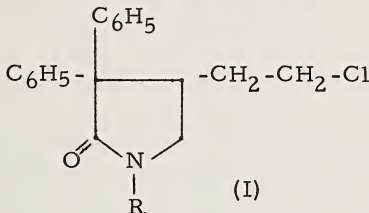
19. Thin layer chromatography has been applied to the separation of a number of aromatic nitro and amino derivatives. The techniques involved in the preparation and development of suitable chromatoplates of mixtures of such structures were considered in detail. With this method it is possible to separate very small concentrations of reduction products formed

in the electrolytic reduction of m-dinitrobenzene, and as a result of the separations and identifications some insight into the electrolytic reduction processes involved is gained. Thin layer chromatography has been found to be a rapid and reliable analytical tool for the separation of the aromatic nitro and amino derivatives.

4-(β -SUBSTITUTED-ETHYL)-3,3-DIPHENYL-2-PYRROLIDINONES, A NEW SERIES OF CNS STIMULANTS, PART II

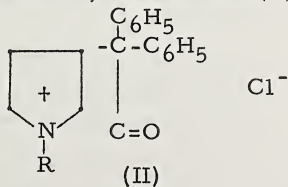
Albert D. Cale, Jr., Carl D. Lunsford, and Herndon Jenkins,
Research Laboratories, A. H. Robins Co., Richmond

23. A previous report (Abstracts of Papers, 141st Meeting of the American Chemical Society, March, 1962) described the preparation of a series of the title compounds and their central stimulant properties. This study has been extended by further variation of the beta substituent. The compounds were prepared by the conversion of an α -(1-substituted-3-pyrrolidyl) α , α -diphenylacetic acid to the corresponding acid chloride and subsequent 'rearrangement' to a 1-substituted-4-(2-chloroethyl)-3, 3-diphenyl-2-pyrrolidinone(I). Further reaction at the 4-chloroethyl



group has led to a series of nitriles, acids, esters, amides, and ketones, as well as a further lengthening of the side chain.

Evidence was presented supporting the formation of I from the acid chloride through the intermediate acyl ammonium ion (II).



Other modifications of I were mentioned.

SPECTROPHOTOMETRIC STUDIES WITH CERTAIN DIAZO DYES
AND THEIR REACTIVITY WITH METALIC IONS;
DETERMINATION OF GALLIUM WITH
1-(2,4-DIHYDROXYPHENYLAZO)-2-NAPHTHOL-4-SULFONIC ACID

Teh Liang Chang and John H. Yoe, *Pratt Trace Analysis Laboratory,
Chemistry Department, University of Virginia*

10. This paper presents a new, sensitive, spectrophotometric method for gallium. 1-(2,4-Dihydroxyphenylazo)-2-naphthol-4-sulfonic acid (DHPAN) forms instantaneously a stable, bright pink, complex with gallium ions. Various conditions and mole ratio studies of the colored complex have been made. At pH 5.8 the complex obeys Beer's law with a maximum absorbance at 560 m μ when read against a reagent blank. For an absorbance of 0.005 the sensitivity is 1 part of gallium in 76,000,000 parts of solution. A spectrophotometric method has been applied to the determination of trace amounts of gallium in a variety of sample solutions.

THIN LAYER CHROMATOGRAPHY OF AROMATIC NITRO AND
AMINO COMPOUNDS

Mary D. Christian, Sam Rose, and H. deSchmertizing, *Melpar, Inc.,
Falls Church*

19. Thin layer chromatography has been applied to the separation of a number of aromatic nitro and amino derivatives. The techniques involved in the preparation and development of suitable chromatoplates of mixtures of such structures were considered in detail. With this method it is possible to separate very small concentrations of reduction products formed in the electrolytic reduction of m-dinitrobenzene, and as a result of the separations and identifications some insight into the electrolytic reduction processes involved is gained. Thin layer chromatography has been found to be a rapid and reliable analytical tool for the separation of the aromatic nitro and amino derivatives.

COMBINATION OF STERIC AND POLAR EFFECTS IN SCHIFF BASE FORMATION

Thomas I. Crowell and Charles E. Bell, Jr., *Chemistry Department,
University of Virginia; Old Dominion College*

20. The rates of reaction of a series of *m*- and *p*-substituted benzaldehydes with both *n*-butylamine and the more hindered *t*-butylamine were measured in methanol solution, at 25° and 45°. A bell-shaped plot of log *k* vs. sigma was obtained. Of three possible explanations, the one

selected is that the proper correlation uses sigma-plus rather than the Hammett sigma function.

It was observed that those values of k which do give a normal Hammett plot also have heats of activation proportional to entropies of activation.

CONDENSED CARBOCYCLIC DERIVATIVES OF PYRROLIDINES

Norman D. Dawson, Carl D. Lunsford, Edward K. Rose and Albert D. Cale, Jr., *Research Laboratories, A. H. Robins Co., Richmond*

24. α , α -Diphenyl- α -(1-ethyl-3-pyrrolidyl)-acetic acid reacts with thionyl chloride to form an acid chloride which undergoes rearrangement to form 1-ethyl-4-(2-chloroethyl)-3,3-diphenyl-2-pyrrolidone. It was deemed of interest to determine whether the facile rearrangement would occur when the phenyl groups were joined together in a heterocyclic system such as xanthene or thioxanthene or in a condensed carbocyclic system as in 10, 11-dihydrodibenzo-[a,e]-cycloheptatriene and 9,10-dihydroanthracene. The chemistry of the reactions investigated was discussed.

CONDENSATION REACTIONS OF HYDROXYLATED ORGANIC COMPOUNDS WITH 1,2-ETHANEDITHIOL

Ann S. Delk and Nancy Harris *Chemistry Department, Mary Baldwin College*

16. The paper was a first report on the attempted condensation of various hydroxylated organic compounds with 1,2-ethanedithiol. Work so far has centered around the use of the phenyl carbinols and the butyl alcohols.

One of the difficulties encountered has been the incomplete reaction of the ethanedithiol. Reactions have made use of two catalysts. Sulfuric acid in acetic acid solutions appears satisfactory in some reactions, but is not useful in others. Para-toluene sulfonic acid in acetic acid was substituted in these, preventing the danger of oxidation.

The preparations obtained were in percentage yields varying from 30% to 98%.

THE INFRARED ABSORPTION SPECTRUM OF LIQUID BF_3

Elizabeth Anne Dodd, Martha Welch Jordan and Ralph G. Steinhart, Jr., *Chemistry Department, Hollins College*

8. The absorption spectrum of liquid BF_3 at -110° has been experimentally studied from 400 cm^{-1} to 5000 cm^{-1} . All major absorption peaks have been identified and compared with previous similar studies

of BF_3 in the gaseous and solid states as well as with previous Raman studies of the liquid. All vibration modes in the liquid lie between the respective modes in the gas and in the solid with the exception of the symmetrical stretch which is lower in the liquid than in either the gas or the solid. The results do not appear to be inconsistent with the existence of a weak B-F-B bond in the liquid as well as in the solid (Dows, D. A., J. Chem. Phys. 31, 1637-9, 1959). The existence of such a bond would also help to account for the anomalously high entropy of vaporization of BF_3 .

SYNTHESIS AND PROPERTIES OF SOME 3,5-DISUBSTITUTED URONS

Allan A. Eisenbraun, C. R. Walter and D. S. Shriver, *Nitrogen Division*

Development Department, Allied Chemical Corporation, Hopewell

22. Fusion of one mole N,N'-dibutylurea with three moles of paraformaldehyde at 120° C for three hours gave 3,5-dibutyluron in 94% yield. Preparation of 3,5-bis(carbethoxymethyl)uron and 3,5-bis(carbomethoxypentyl)uron in yields of 82% and 89%, respectively, was accomplished by fusing one mole of the corresponding disubstituted urea with three moles paraformaldehyde and 0.32 mole boric acid for 1-2 hours at 120-130° C. Stability of the Uron ring was studied using 3,5-bismethoxymethyluron as a model. Stability in alkaline media was high, but was low in acidic media. Some kinetic decomposition data at 70° C were given.

PHOTOCHEMICAL REACTIONS OF METAL CARBONYLS WITH 1,3-DIKETONES AND 8-HYDROXYQUINOLINE

J. C. Goan, T. Iapalucci, E. Berg, and H. E. Podall, *Melpar, Inc.,
Falls Church*

29. Chelates of Fe, Cr, Mo, and W have been formed in a photochemically induced oxidation reduction reaction.

The sources of the metals were the various metal carbonyls and bistrisphenylphosphine iron tricarbonyl. Acetylacetone, hexafluoroacetylacetone, dibenzoylmethane and 8-hydroxyquinoline were used as the chelating agents. Solvents used were benzene, isopropyl ether, carbon tetrachloride, tetrahydrofuran, diglyme, and diphenyl ether. The CO and H_2 given off serve as a driving force for this reaction.

It was found that the rates of these reactions increased with the acidity of the chelating agent and with the temperature as set by the boiling point of the solvent. It was not possible to prepare mixed carbonyl acetylacetonates such as $\text{M}(\text{CO})_m(\text{AA})_n$. In the case of carbon tetrachloride there was probable reaction with the solvent.

AN ELECTRON MICROSCOPIC STUDY OF THE OXIDATION OF COPPER SINGLE CRYSTALS IN AQUEOUS SOLUTIONS OF CUPRIC ACETATE AND CUPRIC SULFATE

C. E. Guthrow, Jr. and G. T. Miller, Jr., *Chemistry Department, Hampden-Sydney College*

2. Electron microscope and electron diffraction techniques were used to study the oxide formed on (110), (100), and (111) faces of copper single crystals exposed to aqueous solutions of CuSO_4 and $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$ for times ranging from 30 seconds to 24 hours. Particular emphasis was placed on preparing smooth, clean, strain-free surfaces of known orientation. In general, the nature of the oxide formed in the two solutions was different. In the $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$ system relatively smooth and continuous films of Cu_2O normally formed while in the CuSO_4 system individual polyhedra of Cu_2O grew from a thin base film of oxide.

STUDIES IN THE 3,6-PYRIDAZINDIONE SERIES

Lowell Heisey, Lawrence Baxter, Allen Rhodes and Stuart Suter, *Chemistry Department, Bridgewater College*

26. There has been a controversy in the literature concerning the tautomeric structure of the plant growth inhibitor, maleic hydrazide. Evidence and data from I.R., U.V., M.M.R., fluorescence spectroscopy, and deuteration studies for the existence of the various forms of this compound were presented.

Some interesting reactions have been encountered in the preparation of related compounds, desired for tests for plant hormone and carcinogenic activity. Saturated and unsaturated cyclic anhydrides, polyhalogenated phthalic anhydrides and anhydrides of alicyclic dicarboxylic acids each gave predominantly a different type of product in condensation reactions with hydrazine. Structural proof of these products was discussed.

SEMIQUANTITATIVE CHARGE-CLOUD PICTURES OF ORBITALS AND BONDS

Frederick M. Hornyak, *Chemistry Department, Virginia Polytechnic Institute*

3. Pictorial representations of hydrogen-like probability density functions were described. Constant density contours in planar sections serve as guides for the application of ink patterns. The simple superposition of the atomic density distributions gives an approximation to molecular orbital patterns.

THE QUANTITATIVE MEASUREMENT OF URINARY PREGNANE-DIOL BY GAS-LIQUID CHROMATOGRAPHY

Mary Ann Hurley and Edward A. Garlock, *Hazleton Laboratories, Inc., Falls Church*

13. The methods for measuring progesterone and its principal metabolite pregnanediol consist of bioassays or complex chemical isolation techniques. With the advent of gas chromatography and the development of high temperature liquid phases, chromatography of steriods in the vapour phase has been accomplished by several groups. A method for the analysis of urinary pregnanediol has been developed in this laboratory consisting of enzymic hydrolysis, solvent extraction, and vapour phase chromatography using a hydrogen flame detector. The standard deviation obtained is $\pm 5.6\%$. The sensitivity per 100 ml. of urine is 7 mg. (per 24 hours) total output. Comparative values have been obtained from normal male and females, pregnant females, and experimental primates.

THE ENTHALPIES AND ENTROPIES OF REACTIONS OF SOME SILVER AND ETHYLENEDIAMINE COMPLEXES

Richard A. Jesser, Jr. and Robert L. Graham, *Chemistry Department, Virginia Polytechnic Institute*

5. A solution calorimeter was constructed and its accuracy was tested by determining the heat of solution of KCl. The temperature measuring device was a bridge circuit using thermistors as the temperature sensitive elements. The heat capacity of the system was determined by electrical calibration. The heats for the following reactions were determined:

1. $\text{Ag}^+ + \text{en} = \text{Ag}(\text{en})^+$
 2. $\text{Ag}^+ + 2\text{en} = \text{Ag}(\text{en})_2^+$
 3. $2\text{Ag}^{++} + 2\text{en} = \text{Ag}_2(\text{en})_2^{++}$
 4. $\text{Ag}^+ + \text{Hen}^+ = \text{AgHen}^{++}$
- en = ethylenediamine

From the reported equilibrium constants, the free energies and entropies were calculated; thereby, providing information on the nature and structure of the reactants.

A NEW SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF MICROGRAM AMOUNTS OF SELENIUM

G. F. Kirkbright and John H. Yoe, *Pratt Trace Analysis Laboratory, Chemistry Department, University of Virginia*

9. The oxidation of phenylhydrazine p-sulfonic acid by selenious acid has been investigated. Trace amounts of selenium have been determined by measurement of the absorbance of $520\text{ m}\mu$ of the azo dyestuff formed when the diazonium oxidation product is coupled with α -naphthylamine. Optimum conditions for the reaction have been established. Beer's law is obeyed from 0.1-1.6 p.p.m. of selenium and the sensitivity is $0.01\text{ }\mu\text{g Se per cm}^2$ for $\log I/I = 0.005$.

SOME REACTIONS OF 2,5-DIHYDROTHIOPHENE 1-OXIDE

Robert C. Krug and Donald E. Boswell, *Chemistry Department, Virginia Polytechnic Institute*

15. 2,5-Dihydrothiophene 1-oxide (I) reacts with bromine and with hydrogen bromide under non-ionic conditions to yield the same product, 1,3,4-tribromotetrahydrothiophene sulfonium bromide (II). Distillation of thermally unstable II produces 3,4-dibromotetrahydrothiophene (III). Under ionic conditions, bromine and hydrogen bromide react with I to yield II. Hydriodic acid reduces I to 2,5-dihydrothiophene (IV).

The reaction of I with *p*-toluenesulfonamide yields the corresponding sulfilimine (V).

A new method of synthesis of I was reported.

THE THERMODYNAMICS OF THE PARTITION OF 8-HYDROXYQUINOLINE BETWEEN SEVERAL ORGANIC SOLVENTS AND WATER

Irving Lipschitz and John G. Mason, *Chemistry Department, Virginia Polytechnic Institute*

28. The pK_a for protonated 8-hydroxyquinoline has been determined as a function of temperature in acetic acid-sodium acetate buffers at a total ionic strength of 0.11 M by a spectrophotometric method. ΔH for the ionization was found to be $-5.7 \pm 0.3\text{ Kcal}$, $\Delta S = 4.2\text{ e. u.}$ over the temperature range $25 - 45^\circ\text{ C}$.

The partition of 8-hydroxyquinoline between benzene and water, and toluene and water has been studied as a function of temperature and pH. From these data, the following values were found

$$\Delta H_{C_6H_6-H_2O} = -0.05 \text{ Kcal}, \quad \Delta S_{C_6H_6-H_2O} = 11.0$$

$$\Delta H_{tol-H_2O} = 0.9 \text{ Kcal}, \quad \Delta S_{tol-H_2O} = 13.7$$

for the partition process.

A NOVEL PHENYL GROUP MIGRATION

Robert E. Lutz, John I. Dale, and David W. Boykin, Jr., *Chemistry Department, University of Virginia*

17. The structure of *sym-bis*-(2, 3, 5, 5-tetraphenyl-2-dihydrofuranyl)-hydrazine, made by the action of hydrazine on 2, 3, 5, 5-tetraphenyl-dihydrofuranol-2, was demonstrated by reactions and spectra. Pyrolysis and photolysis caused intramolecular oxidation-reduction giving nitrogen and the unsaturated ketone, 1, 2, 3, 4-tetraphenyl-3-butene-1-one. Phenyl group migration transannularly with respect to the *bis* hydrazine, had occurred and was confirmed by tracer study using C^{14} labelled 5-phenyls. A mechanism involving ring contraction through a cyclobutenol was excluded by another tracer study using *bis* hydrazine C^{14} labelled at the 5-carbon. The probable mechanism involves a carbene-like or dihydrofuran intermediate, with drive furnished by relief of strain at the 5-carbon through phenyl migration coupled with ring opening to the relatively stable acyclic unsaturated ketone.

THE DEVELOPMENT OF A RESEARCH ORIENTED UNDERGRADUATE CHEMISTRY CURRICULUM

G. Tyler Miller, Jr., *Chemistry Department, Hampden-Sydney College*

1. An undergraduate curriculum was described in which conventional laboratory experiments are replaced by independent research projects. Freshmen students work on open-ended creative projects. This is followed by a two year laboratory sequence in organic and physical chemistry in which the student uses modern instruments and techniques to synthesize, purify, and characterize new organic compounds and to make precise measurements of their physical, electrical, thermal, and optical properties. Outstanding students gain up to three and one-half years of additional research experience by beginning participation in a major departmental research program as early as their freshman year.

POSSIBLE APPLICATION OF POSITRON ANNIHILATION TO ANALYTICAL
CHEMISTRYRobert C. McIlhenny, *Melpar, Inc., Falls Church*

12. The presentation was based on a thorough review of the literature dealing with positron annihilation. Although all phenomena predicted by physicists have been observed experimentally, certain other experimental annihilation phenomena that were not predicted have been observed; not all of these phenomena have been explained satisfactorily. It is this latter group of phenomena that afford possibilities for the analyst. Most promising applications appear to be for qualitative tests, with quantitative analysis possible in some specific instances. The chief attractiveness of these applications is that they are non-destructive. Background information, experimental techniques, and examples of possible applications were presented. (This work was supported in part by the Army Chemical Corps under contract number DA-18-105-405-CML-828).

A NEW SPECTROPHOTOMETRIC METHOD FOR MANGANESE

LeRoy Pike and John H. Yoe, *Pratt Trace Analysis Laboratory, Chemistry
Department, University of Virginia*

11. The method is based upon a colored complex formed by manganese (III) reacting with N, N, N', N' tetra(2-hydroxypropyl)ethylenediamine. At pH 6 the complex has an absorption maximum at 500 m μ . Beer's law is obeyed up to 100 ppm manganese. The optimum range is 20 to 80 ppm and the practical sensitivity is 1 part of manganese in two million parts of solution.

INVESTIGATIONS OF AN INTERESTING REARRANGEMENT OF
DIPYRIDYL SULFIDESO. R. Rodig, R. K. Schlatter, Jr., and R. C. Collier, *Chemistry Department, University of Virginia*

27. Although usually considered to be a base catalyzed reaction, the Smiles rearrangement of 3-amino-2,2'-dipyridylsulfides and their N-acetyl derivatives was found to be catalyzed by heat and acid as well as base. In the case of the heat catalyzed rearrangement of the N-acetyl derivatives, solvent effects were observed. Examples were cited where compounds underwent rearrangement in the solid state.

THE SYNTHESIS OF γ -SEMICARBAZIDOBUTYRIC ACID

James K. Shillington, G. Ashley Allen, and Hugh Trout, III, *Chemistry Department, Washington and Lee University*

31. A continuation of the study of the synthesis of bifunctional carbonyl reagents for use in the isolation and identification of aldehydes and ketones was presented. γ -Pyrrolidone was opened in the presence of barium hydroxide. The γ -aminobutyrate, thus formed, was reacted directly with nitrourea and the γ -ureidobutyric acid was isolated. All attempts at direct hydrazination of the urea to the semicarbazide failed. The related urea nitrate was prepared and converted in good yield to the γ -nitroureidobutyric acid (I). The chemical and catalytical hydrogenation investigations of (I) are being carried out.

THE SYNTHESIS OF 4-CARBOXYBENZENESULFHYDRAZIDE AND ITS USE AS A CARBONYL REAGENT

James K. Shillington, Edward B. Eadie, Jr., Thomas W. Fauntleroy, Jr., and F. Scott Kennedy, Jr., *Chemistry Department, Washington and Lee University*

32. In view of the recent studies of p-tosylhydrazide as a carbonyl reagent and of the vast improvements brought about in the synthesis of this material from p-toluenesulfonyl chloride, the investigation of the preparation of 4-carboxybenzenesulfhydrazide for use as a bifunctional carbonyl reagent in the isolation and identification of aldehydes and ketones has been undertaken. 4-Carboxybenzenesulfonyl chloride (I) is commercially available. Treatment of (I) was hydrazine hydrate solution followed by careful adjustment of pH is one such parallel preparation of this compound.

FURTHER STUDIES ON THE CONVERSION OF NICOTINE TO NORNICOTINE IN TOBACCO

W. Stepka and L. J. Dewey, *Research Laboratories, American Tobacco Company, Richmond*

33. The conversion of nicotine to nornicotine by leaves from a strain of cigar tobacco has been studied with the aid of C¹⁴-labeled nicotine and also with the aid of alkaloid-free leaves obtained from tobacco shoots grafted onto tomato stocks.

The data obtained permitted the intermediary role of nicotine-1'-oxide in the conversion to be ruled out. Additionally, the alkaloid-free leaves

provided a convenient system for testing, (a) the specificity of the reaction and (b) the possible intermediary role of a number of other related compounds.

THE HYDROTHERMAL TREATMENT OF AFWILLITE, $\text{Ca}_3(\text{SiO}_3\text{OH})_2 \cdot 2\text{H}_2\text{O}$

H. F. W. Taylor and A. W. Nicol, *University of Aberdeen, Scotland and Materials Research Laboratory, Pennsylvania State University*

6. Afwillite ($\text{Ca}_3(\text{SiO}_3\text{OH})_2 \cdot 2\text{H}_2\text{O}$), on hydrothermal treatment at around 400°C and 270 bars, undergoes oriented transformation to xonot-

lite, foshagite or 9 \AA tobermorite. The relative orientations of starting material and products have been worked out. The CaO/SiO_2 ratios of the products are all less than that of afwillite and a mechanism for the transformation was proposed which involves migration of silicon atoms through a relatively unchanged lattice of calciums and oxygens. The reaction is catalyzed by hydrogen ions from the water and probably also depends on the presence of $\text{Si}-\text{OH}$ in the structure of afwillite.

INFRARED STRUCTURE SPECTRA CORRELATION IN SUBSTITUTED OLEFINS

W. L. Truett, 'Orlon' Technical Division, Benger Laboratory, E. I. duPont de Nemours & Co., Waynesboro

18. There are five types of olefins and each type shows characteristic absorption in the IR between 10 and 15μ : vinyl, vinylidene, trans, cis and triply substituted. When the simple structure of the olefin is modified by polar factors, conjugation, ring strain, steric bulk or inclusion in a polymer structure the normal wavelengths may change markedly. From a consideration of approximately 1,000 examples in the literature, a set of correlations has been derived which permit the prediction of absorption wavelengths for virtually every type of substituted olefin. Certain general conclusions were drawn and brief consideration was given as to the effect on band intensity.

2-BROMONAPHTHALENE

F. A. Vingiello, P. Polss and D. Farrier, *Chemistry Department, Virginia Polytechnic Institute*

4. 2-Bromonaphthalene has served as an important starting material for many research projects (see for example, F. A. Vingiello, A. Borkovec, and W. Zajac, J. Am. Chem. Soc., 80, 1714 (1958)). Recently, large quantities of 2-bromonaphthalene were needed and it was found that the available methods of preparation were either unsuitable or actually erro-

neous. An improved method of preparation of 2-bromonaphthalene, which is suitable for the preparation of large quantities of very pure material, was reported upon. The material is suitable for Grignard reagent formation.

THE SYNTHESIS AND REACTIONS OF SOME NEW COMPLEX KETONES
CONTAINING *ortho* HALOGEN

F. A. Vingiello, L. Ojakaar and J. Yanez, *Chemistry Department, Virginia Polytechnic Institute*

30. As a continuation of the work with polynuclear compounds (F. A. Vingiello and W. W. Zajac, *J. Org. Chem.*, 26, 2228 (1961)) and with ketones containing *ortho* substituents (F. A. Vingiello, M. O. L. Spangler, and J. E. Bondurant, *J. Org. Chem.*, 25, 2091 (1960)) several new 2-(2-naphthylmethyl)phenyl 2'-substituted phenyl ketones were prepared. These ketones, which have an *ortho* halogen atom, require a special method of preparation relative to those containing the halogen atom in a *meta* or *para* position. The successful preparation of these new ketones containing an *ortho* halogen atom as well as some reactions of the ketones were discussed.

MICROSTRUCTURAL OBSERVATIONS OF BORON FILAMENTS

Franklin E. Wawner, Jr., *Texaco Experiment Incorporated, Richmond*

7. The structural and microstructural aspects of boron filaments, produced by the hydrogen reduction of boron halides onto small-diameter tungsten wire, were described in an attempt to characterize them broadly with respect to their surface, bulk, and core.

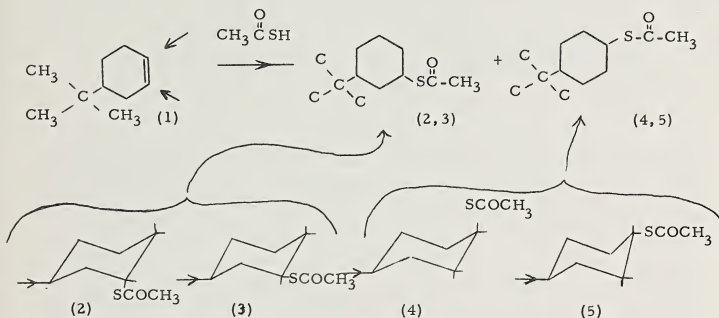
It has been seen that the deposited boron diffuses into and reacts with the tungsten to form two boride phases. Subsequently deposited boron, at the deposition temperature used for these experiments, forms a homogeneous monocrystalline layer. The surface of the filament can be described as having oriented nodules separated by definite boundaries. Specific areas of fundamental importance to the mechanical properties of the filaments are indicated.

RESISTANCE AT A DISTANCE — STEREOCHEMISTRY OF FREE-RADICAL
ADDITION OF THIOLACETIC ACID TO 4-TERT-BUTYLCYCLOHEXENE

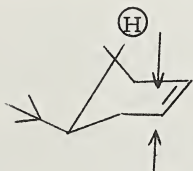
George S. Whitney, *Chemistry Department, Washington and Lee University*

34. Thiolacetic acid — CH_3COSH — adds to double bonds by a free

radical process. Two carbons are sites for attack by $\text{CH}_3\text{COS}\cdot$ radical in 4-*tert*-butylcyclohexene.



Both 4- and 3-*tert*-butylcyclohexyl thioacetates have *cis* and *trans* isomers (4, 5 and 2,3 respectively). In actual experiment, all four compounds are obtained, but there is an unexpected predominance of thioesters (2) and (4) over (3) and (5) whereas equal amounts of *cis* and *trans* might have been predicted. This leads us to suspect that some resistance to the radical attack leading to (3 and (5) is being encountered. Models show that a *distant* hydrogen, four carbons away may obstruct attack from one side, and thus reduce the amount of addition from that side.



attack leading to *cis*-3, or (3)

attack leading to *trans*-3, or (2)

Proof of structure rests on conversion of the four isomers to benzyl sulfones, followed by isomerization; and quantitative estimates result from their chromatographic separation.

SECTION OF ENGINEERING

J. F. Eckel, *Chairman*J. A. Friedericy, *Vice-Chairman*R. K. Will, *Secretary*N. F. Murphy, *Section Editor*R. H. Hubbard, *Historian*

MINUTES

The possibilities of selected papers were explored. Some discussion took place on the philosophy of the acceptance of all papers versus the invitation of selected speakers. Final suggestion by Dr. Murphy was 'leave the decision on this matter to next year's Section Chairman.'

Officers elected for 1963-64 were: *Chairman*, Johan A. Friedericy, Dept. of Civil Engrg., University of Va.; *Vice-Chairman*, R. K. Will, Dept. of Mechanical Engrg., Virginia Polytechnic Institute; *Secretary*, H. G. Larew, Dept. of Civil Engrg., University of Virginia. Also elected was John F. Eckel, Chairman, Metallurgical Dept., Virginia Polytechnic Institute, as *representative to the Council*.

Johan A. Friedericy, *Acting Secretary*

LATERAL RANGE AND HYPERSONIC LIFT-DRAG RATIO REQUIREMENT FOR EFFICIENT FERRY SERVICE FROM A NEAR-EARTH MANNED SPACE STATION

Donald L. Baradell and Charles H. McLellan, *National Aeronautic and Space Agency*

11. This paper examines the geometry of the space station ferry ranging problem, in order to determine the lateral ranges required to reach prechosen landing sites from near earth orbits, and to investigate and compare several means of achieving these ranges.

It is shown that the lateral range requirements for ferry service depend strongly on the inclination of the space station orbit, the number and location of acceptable landing sites and the delay time capabilities of the ferry system. The types of vehicle required to furnish these ranges aerodynamically run from an advanced vehicle with a hypersonic L/D of about 3.6 which could provide the optimal service of return to any point on earth once each orbit, down to a near ballistic vehicle with an L/D on the order of one-tenth which could provide the minimal service of once daily return to a properly selected landing site. In comparing

the weights required to achieve lateral range by several methods, it is shown that the use of propulsion in space is competitive weightwise with aerodynamics for achieving small amounts of lateral range, but that for achieving large values of lateral range, aerodynamics is superior to all other methods considered.

STRENGTH OF COMPACTED MICA-QUARTZ SAND MIXTURES

H. S. Bhat and R. D. Krebs, *Virginia Polytechnic Institute*

7. Study of compounded biotite mica-quartz sand mixtures was conducted to determine the effect of sand content on the compaction characteristics and shearing resistance of micaceous soils. It was found that for kneading compaction, maximum dry density increased and optimum water content decreased with an increase in sand content. Also, a linear relationship exists for optimum water content versus maximum dry density for soil biotite with sand contents of from 0 to 75 percent. Similar results were obtained with butanol as the soil pore fluid. Sand additions to biotite increased the modulus of elasticity and reduced the unconfined compressive strength and modulus of elasticity from values obtained with water. Triaxial quick tests showed that sand addition increase the angle of shearing resistance of as-compacted soil mica, especially with butanol as the pore fluid. Conversely, sand reduced the cohesion parameter, especially with butanol samples. These results are discussed in the light of current theories on soil structure and the role of surface tension on the properties of compacter soil.

DEVELOPMENT OF AN IGNITION CRITERION FOR TURBULENT, HIGH VELOCITY, PILOT STABILIZED FLAMES AT LOW PRESSURE

Richard G. Griskey, *Virginia Polytechnic Institute*

2. Ignition criteria have been developed for such cases as spontaneous ignition and ignition of turbulent, flowing gases with a spark. No such criteria, however, were proposed for systems using a pilot stabilized flame.

This investigation was undertaken to develop such a criterion. The basis used was to balance over the induction period the thermal energy needed to raise an initially reacting element to the ignition temperature with the thermal energy derived from both the pilot flame and a fraction of the element's heat of combustion.

Experimental data for the butane-air system in the form of limiting velocity-ignition composition curves (1.8 to 3.2 mole % butane, velocities up to 666 ft/sec and turbulence intensities up to 7%) were used to check the criterion. Ignition temperatures calculated from the criterion

compared favorably with published data. A similar result was obtained for calculated induction period data.

The criterion was also used to fully delineate the limiting velocity-ignition composition curves for the butane-air system. These curves were extended from 3.2 to 8.6 mole % for all turbulence intensities.

SOME ASPECTS OF MAGNETOHYDRODYNAMIC FLOWS

William Grossmann, Jr., *National Aeronautics and Space Agency*

14. A class of magnetohydrodynamic channel flows has been analyzed for the case of annular, viscous, heat-conducting gas with large swirl velocity. The case of low magnetic Reynolds number allows neglecting the usual Maxwell equations and the only constitutive equation necessary then is the generalized Ohm's Law. It was found that two nindimensional parameters govern the flow profiles; the Hartmann number and a quantity which is equal to the ratio of applied voltage to induced voltage. Results indicate that at high Hartmann numbers, there is a tendency to straighten out the velocity profile to something that represents wheel-like motion. Solutions are given for a large range of the two governing parameters.

RECENT TRENDS IN THE PATENT SYSTEM

Auzville Jackson, Jr., *Robertshaw Controls Company*

4. Some of the most important recent trends of the patent system involve the need for considering patents on a world-wide basis, the need for a new examining procedure to cope with the increased complexity and quantity of patent applications, and a re-evaluation of who should own a patent initially — the inventor, the corporate employer or the U. S. Government.

A₃B STRUCTURES IN THE V-Rh-Si TERNARY SYSTEM

Robert V. Lawrence, *Virginia Polytechnic Institute*

5. The V-Rh-Si system is being investigated as one of several ternary systems to provide phase equilibria data for the eventual determination of factors governing the formation of A₃B compounds. Investigation across the V-Rh-Si ternary system at 75 atom %V (substituting Si for Rh in 5 atom percent increments) has shown that there is complete solid solubility of Si for Rh. Lattice parameter measurements of the binary compounds V₃Rh and V₃Si are in very good agreement with published data.

ELECTRODEPOSITION OF CHROMIUM-MOLYBDENUM ALLOYS

H. L. McCutchen and Nelson F. Murphy, *Virginia Polytechnic Institute*

10. Recent literature sources indicate that chromium-molybdenum alloys can be electrodeposited. Alloys containing up to three percent molybdenum appear very similar to chromium deposits, but above eight percent molybdenum the alloys are dark and powdery.

The fact that 1% addition of molybdates reduces the efficiency of chromium plating ninety per cent, and that there should be no solubility limit for molybdenum in chromium indicates that the chromium-molybdenum alloys are not bimetallic alloys but are inclusions of molybdenum oxides in the chromium deposit.

TRANSONIC AERODYNAMIC CHARACTERISTICS OF A MISSILE SHAPE WITH SEVERAL REPRESENTATIVE FLIGHT DEFORMATIONS

John P. Mugler, Jr., *National Aeronautics and Space Agency*

13. The aerodynamic characteristics of four ogive-circular cylinder bodies of revolution are presented at Mach numbers from 0.4 to 1.2 for angles of attack from about minus 10 degrees to plus 14 degrees. One body serves as a reference and the three additional bodies differ from the reference body in the camber of the body center line. The data shows that body deformations can markedly change the aerodynamic characteristics. Comparisons between the experimental data and calculated results using slender body theory showed that although the characteristics of the reference body could be predicted reasonably well, predictions for the cambered bodies were poor.

PORTLAND CEMENT CONCRETE DISTRESS RESULTING FROM PLASTIC SHRINKAGE

Howard H. Newlon, Jr., *University of Virginia*

9. This paper describes an investigation of distress in the form of random cracking in a concrete bridge deck. On the basis of an analysis of construction records, weather data and a petrographic examination of a hardened concrete core, it is shown that the cracking occurred while the concrete was in a plastic state, a phenomenon described as plastic shrinkage cracking. This resulted largely from an unusual combination of circumstances which caused excessive drying of the surface.

HYDRAULIC DISRUPTION AND REENTRAINMENT OF FROTH

W. A. Parsons, D. F. Alt and H. R. Bungay, III, *Virginia Polytechnic Institute*

6. Frothing, the formation of foam on the surface of liquids during aeration or agitation, is a problem associated with aerated microbial fermentations employed for the treatment of water borne wastes and for the production of pharmaceuticals. No prevailing method of control of frothing is entirely satisfactory.

The investigation of hydraulic disruption and reentrainment of froth was made on a 420 gallon scale. The process consisted of the collection and capture of froth in a covering downflow. Methods were developed for evaluation of the performance of the process in terms of the time required to produce a definite volume of froth with fixed aeration rate and dosage of frothing agent.

Frothing control was realized to the extent that it required 5.7 times as long to create a specified volume of froth with the unit in operation as when the unit was out of operation. The geometry of the inlet and rate of downflow were indicated as principal variables.

The limited investigation did not establish the optimum performance of the process.

THE EFFECT OF ORBITAL ALTITUDE ON RETRO THRUST AND REENTRY

REQUIREMENTS FOR RETURN FROM A MANNED SPACE STATION

E. Brian Pritchard, *National Aeronautics and Space Agency*

12. This investigation was concerned with the determination of reentry requirements for a space ferry vehicle operating between the earth and a manned space station. Two types of space station orbits were considered: circular orbits with altitudes from 200 to 22,550 statute miles and reconnaissance ellipses having a 100 mile perigee altitude and an apogee altitude of from 200 to 22,550 statute miles.

Initial entry velocity was found to vary from about 24,000 ft/sec for return from a 200 mile orbit to 34,000 ft/sec for the 22,550 mile orbit. Initial entry velocity was found to be essentially invariant with increasing initial entry angle for return from orbital altitudes greater than about 1,500 miles for the range of initial entry angles considered (0 to -12°).

Propellant weights required to carry out the retro thrust maneuver were obtained for a propellant having a specific impulse of 300 seconds. Up to 40 per cent of the space ferry vehicle weight is required for retro

thrust propellant to initiate the descent from the space station to the earth.

For the range of entry angle considered (0 to -12°), an optimum orbital altitude of 1,000 miles is obtained from space ferry vehicle considerations only.

SECONDARY COMPRESSION AND SOIL CHARACTER

D. W. Smith and R. D. Krebs, *Virginia Polytechnic Institute*

8. It has been hypothesized that secondary soil compression is a visco-elastic creep or slippage among individual soil grains. Still, an acceptable quantitative approach to soil voids reduction Δe , by secondary compression beneath foundations has yet to be formulated in simple terms. In this study, quartz silt was rendered especially compressible by additions of biotite mica, which is thought to act like a viscous medium in the presence of quartz and water. The secondary compression that resulted was found to vary directly with effective stress and time such that $\Delta e = K \log p \log t$. K varied little among the silts studied, despite differences in mica content. Theory suggests that K is a function of adsorbed pore fluid viscosity for normally consolidated mineral soils. Accordingly, further study may demonstrate a direct relation between K and compression index.

RESEARCH ON NAILS AND NAILING PROCEDURES: DETERMINATION OF WITHDRAWAL RESISTANCE OF NAILS

E. George Stern, *Virginia Polytechnic Institute*

3. Testing procedures for determining the nail-withdrawal resistance offered by different woods are prescribed in the Standards of the American Society for Testing and Materials. ASTM Standards do, however, not exist for the determination of the withdrawal resistance of different nails. Consideration is being given to the preparation of such standards.

In order to provide a basis for the establishment of acceptable methods of evaluating the withdrawal resistance of nails, round-robin tests were performed by the following laboratories:

- 1) Rossford Army Depot Ordnance Packaging Agency, Toledo, Ohio
- 2) U.S. Army Engineer Research & Development Laboratories, Fort Belvoir, Va.
- 3) U.S. Department of Agriculture Forest Products Laboratory, Madison, Wis.

- 4) Virginia Polytechnic Institute Wood Research Laboratory, Blacksburg, Va.

The establishment of testing standards is important since they allow uniform evaluation of materials and processes. The evaluation of the numerous variables in nail design and manufacture, on a uniform basis, is desirable to make valid comparisons possible. The information obtained will be helpful in establishing such standards. Unbiased test data based on such standards will make it possible to specify desirable and economical nails for a given application. Consequently, the presented information will be of value to all concerned with fastening of wood, be it during assembly of a box or during erection of a house.

SECTION OF GEOLOGY

B. W. Nelson, *Chairman*

K. F. Bick, *Vice Chairman*

R. L. Ellison, *Secretary*

W. T. Parrott, *Section Editor*

Minutes

In the absence of B. W. Nelson, Chairman of the Section, the meeting was called to order at 3:00 P.M., 3 May 1963, by K. F. Bick, Vice Chairman. The minutes of the 1962 business meeting were read and approved.

The nominating committee, consisting of E. W. Ramsay (chairman), E. Ern, and S. Kozak, presented the following slate of candidates for Section offices: *Chairman*, K. F. Bick; *Vice Chairman*, J. A. Redden; *Secretary*, R. L. Ellison; and *Section Editor*, W. T. Parrott. It was moved and seconded that the nominations be closed, and the candidates were declared elected.

The meeting was adjourned at 3:05 P.M.

R. L. Ellison, *Secretary*

WEATHERING OF TERRACE BOULDERS IN CHESTERFIELD COUNTY, VIRGINIA: A MINERALOGICAL STUDY

R. I. Barnhisel and C. I. Rich, *Virginia Polytechnic Institute*

12. X-ray diffraction patterns were obtained for the 12 weathering boulders, the material separating these boulders, and three soil horizons of the profile above these samples. It was found that these rocks could be placed

into four groups: (1) Boulders containing primarily kaolinite, (2) those containing primarily montmorillonite, (3) those which contained more kaolinite than montmorillonite, and (4) those which contained more montmorillonite than kaolinite.

In addition, mica, quartz, feldspar, and halloysite were found in many samples. The halloysite was identified by the electron microscope, whereas the other minerals were identified from the x-ray diffraction patterns.

It is significant that boulders from apparently different parent rocks were weathering to different types of clay minerals, namely kaolinite and montmorillonite, with a few inches of each other. This is additional evidence of the importance of parent rock in the formation of soil clay minerals.

AMETHYST LOCALITY NEAR ASH LAWN

R. J. Bland, Jr., G. A. Gatlin and S. S. Johnson, *University of Virginia*

10. Amethyst was first found in the Ash Lawn area, 3.5 miles south of Charlottesville, approximately twenty years ago. Recently a large number of crystals were uncovered in a new road cut.

The pale lavender to deep violet amethyst is found associated with a highly jointed, magnetite rich, meta-arkose. The size ranges up to 3 inches for single crystals and up to 6 inches for clusters. Septers, phantoms, and doubly terminated crystals are common. Inclusions present are gas bubbles, clay, and goethite needles with c axis elongation. Few of the crystals are of gem quality.

It is impossible to determine the total amount of material taken from this locality, but it is estimated that over 75 pounds of crystals have been removed since May, 1962.

The locality is not a good collecting site at the present time, because the small road cut in which the crystals occurred has been thoroughly searched by numerous collectors. However, it is believed that the area does have great potential.

WEATHERING OF TERRACE BOULDERS IN CHESTERFIELD COUNTY, VIRGINIA: A THIN SECTION STUDY

S. B. Cotton and C. I. Rich, *Virginia Polytechnic Institute*

11. Weathering of idiomorphic muscovite surfaces, as well as interlamellar regions, to an unidentified clay mineral was observed. Biotite appeared to be weathering at a much faster rate than muscovite, many biotite grains

having been weathered completely to vermiculite whereas a few others have weathered around their edges exhibiting some pleochroism in the centers. Inclusions in quartz were found to be completely weathered. Although, in some instances typical clay skins were observed. Several other argillans (clay skins) were interpreted as being biotite relics. Vermiculite, vermicular kaolinite and montmorillonite-halloysite associations were found to be weathered in place. Weathered rock fabric and clay mineral associations were seen in the thin sections and were used to interpret the degree to which the mineral were formed "in situ." Photomicrographs illustrate these aspects of the clay minerals found.

MINERALOGY OF MARBLES IN THE LEESVILLE-ALTAVISTA AREA, VIRGINIA

John E. Cowlbeck, *Virginia Polytechnic Institute*

13. Marbles in the Altavista area include a white relatively pure interbedded dolomite and calcite marble (Mount Athos?) and a blueish gray, impure, largely calcite marble (Arch Marble). In the garnet metamorphic zone, the white marble contains quartz, actinolite, magnesium, biotite, chlorite, epidote, muscovite, tourmaline, and rutile in the chlorite. The mineralogy is about the same in the sillimanite zone but the grain size is considerably larger. Nearly equal amounts of calcite and dolomite constitute from 89 to 95 percent of the chip samples across exposures of the white marble. The carbonate content is adequate for commercial use but all exposed sections are relatively thin.

The blue impure marble contains quartz, chlorite, phlogopite, muscovite, albite, and graphite in the biotite zone. In the sillimanite zone it contains quartz, diopside, actinolite, biotite, epidote, calc plagioclase, and scapolite, and graphite.

UPPER CAMBRIAN TRILOBITES FROM THE ELBROOK AND CONOCOCHEAGUE FORMATIONS OF THE DAMASCUS AREA, WASHINGTON COUNTY, VIRGINIA

James R. Derby, *Virginia Polytechnic Institute*

Several collections of Upper Cambrian trilobites were made by the writer while mapping the Damascus Area. The largest collection, a composite from several localities, came from a 100-160 foot thick oolitic calcarenite member at the top of the Elbrook as mapped by Butts. This collection contains: *Coosina ariston*, *Coosina sp.*, *Blountia sp.*, *Crepicephalus rectus*, *Crepicephalus sp.*, *Meteoraspis mutica*, *Maryvillia arion*, *Terranovella dorsalis*, *Tricrepicephalus thoosa*, *Llanoaspis modesta*, *L. peculiaris*,

Kingstonia walcotti, *Pemphigaspis* sp., *Komaspidella laevis*, and several agnostids. These genera form a typical cratonic assemblage of the Crepicephalus Zone of the Upper Cambrian Dresbachian Stage, and confirm Butts' assertion that the top of the Elbrook is equivalent to the Nolichucky Formation.

The second collection consists of five specimens of *Plethometopus convexus* which were found 580 ft. above the base of the Conococheague formation in a gray, thin bedded calcarenite near Pleasant View Church in Widener Valley, 4 miles N. of Damascus. Various species of *Plethometopus* have been reported from the upper few hundred feet of the Conococheague in northern Virginia and from the middle of the Copper Ridge dolomite in central Tennessee. In both cases other faunal elements indicate a Trempeleau age. A Trempeleau or late Franconian age therefore seems to be indicated for the *Plethometopus* horizon in the Damascus area however over 1000 feet of Conococheague limestone and dolomite overlie this horizon. If the custom of placing the Cambro-Ordovician boundary at the upper sandstone beds of the Conococheague is justified, a Trempeleau age for the *Plethometopus* horizon seems unlikely. Possibly *Plethometopus* ranges well down into the Franconian in the Southern Appalachians.

STRATIGRAPHY AND STRUCTURE OF THE DAMASCUS AREA, WASHINGTON COUNTY, VIRGINIA

James R. Derby, *Virginia Polytechnic Institute*

4. The Damascus area, comprising the eastern 2/3 of the USGS 7½" Damascus Quad., was mapped by the writer in 1960-1961 as an M.S. thesis at V.P.I. Marine sedimentary rocks in the area range in age from Early Cambrian(?) to Middle Ordovician, a total thickness of approximately 13,000'. The stratigraphic succession is as follows: Chilhowee group, 3600'; Shady dolomite, 1200'; Rome fm, 1400'; Elbrook fm., 1700'; Conococheague fm, 1700'; Barron Creek limestone (= "Chepultepec" of Butts, 350'-850'; Aven fm. (= "Beekmantown" of Butts), 600'-800'); Lenoir-Mosheim limestone, 0'-86'; Fetzner limestone, 0'-18'; Effna limestone, 0'-10'; Paperville shale, approximately 300'; Knobs fm., (= Tellico?) at least 400'. The new formation names were proposed by Tyler in 1960 in a V.P.I.-M.S. thesis. The Elbrook formation is newly subdivided into four clearly recognizable members; a lower shaly dolomite, 700' ±; a middle limestone, 350'; an upper dolomite, 470'; and the uppermost Widener limestone, 100'-160', which contains a *Crepicephalus* zone fauna. Previously unreported faunas include a large collection of *Finkelnburgia bellatula* from the top of the Barron Creek, and *Lecanospira compacta* from near the top of the Aven.

The strata have been folded into five synclines and four anticlines, and

are broken by two major thrust faults, the Holston Mtn. thrust and the newly named Lodi thrust. The strata in the Lodi thrust sheet are sub-parallel to the underlying folded beds and are overturned in the trough of a major syncline, suggesting that faulting occurred while folding was in progress.

NOLICHUCKY TRLOBITES FROM DECKER'S GRAPTOLITE LOCALITY NEAR GRATTON, VIRGINIA

James R. Derby, *Virginia Polytechnic Institute*

5. In 1958 Decker and Gold in the *Journal of Paleontology* described two collections of dendroid graptolites from the Nolichucky formation in Virginia and Tennessee. These graptolites are either the oldest known graptolites in North America or are only slightly younger than the *Dictyonema* reported by Shaw from the Hungerford slate of New York. The graptolite locality described herein, first reported by B. N. Cooper in his Burkes Garden report, is located 8800 feet N57°E of Gratton, Tazewell county, Virginia, in the SE ninth of the TVA 7½" Tiptop Quad. Unfortunately no trilobites were identified from this locality so the age of the graptolites with respect to trilobites, the zonal fossils, was unknown.

The total exposed Nolichucky is 65 feet thick. At the base of the exposure, directly underlying the 5 inches of shaly limestone containing Decker and Gold's lower graptolite horizon, is a 1-foot bed of calcarenite containing *Ilanoaspis modesta*, *Blountia* sp., and *Tricrepicephalus* sp. librigena. Sixteen feet above this limestone is a five-foot bed of shale containing numerous specimens of *Aphelaspis* sp. Decker and Gold's upper graptolite horizon is in shaly interbeds in limestone and dolomite 38 feet above the base of the exposure and 17 feet above the *Aphelaspis*-bearing beds. The lower trilobite assemblage and lower graptolite zone undoubtedly belong to the *Crevicephalus* zone of the (Upper Cambrian) Dresbach stage. The upper graptolite zone, although overlying the *Aphelaspis*-bearing beds, is probably referable to the *Aphelaspis* zone.

GEOLOGY AND THE LOCATION OF ECONOMIC ACTIVITY IN CLARKE AND FREDERICK COUNTIES, VIRGINIA

S. T. Emory, Jr., *Mary Washington College*

3. Clarke and Frederick Counties occupy the northernmost part of the Great Valley in Virginia, as well as the adjacent parts of the Blue Ridge and Valley and Ridge. Geology effects the location of the cropland, pasture, orchards, transportation routes, retail trade, industry, and recreational developments.

In the Great Valley crops are grown on the deeper limestone and alluvial soils, pasture is located in areas of limestone outcrop, and apple orchards are located on the Conococheague limestone which offers some protection from frost. The interfluvial areas underlain by Martinsburg shale are used for inferior agricultural land, while the steam valleys are forested. The Blue Ridge is almost completely forested as are the ridges of the valley and Ridge. The valleys of the Valley and Ridge are used for agriculture.

Transportation facilities are governed by the strike of the valleys and the location of gaps. These transportation routes govern the location of retail trade outlets and industry which tends to locate on the Beekmantown limestone. Recreational facilities are located on the ridges formed by the Blue Ridge and the Tuscarora sandstone.

FOUNDATION PROBLEMS WITH INDURATED CLAYS

Ernest H. Ern, *University of Virginia*

2. A series of highlift, lock-chambered, navigation dams are in the design and/or early construction stage on the Ohio River by the Huntington District (Belleville, Racine and Willow Island Dams), and Pittsburgh District (Pike Island Dam) Offices of the U. S. Army Corps of Engineers.

The foundation rock for these projects involves the lower Washington Series of Permian Age which consists of highly variable, lensing horizons of sandstone, siltstone, shale and indurated clay. The major consideration is one of constructing the wall monoliths over, in, or below the irregularly slickensided indurated clays which are encountered at depth. Laboratory test results show a wide, conflicting range of strength values. It is possible that these tests reflect a lower value of foundation strength as a result of changes in the indurated clay caused by the actual drilling and sampling of the material.

Field tests on the exposed indurated clays are discussed in regard to direct and triaxial shear failure and plate-bearing tests.

At the Belleville Lock and Dam site it was considered advisable to go to a two-stage construction scheme. First, construct a cofferdam, de-water, and excavate the overburden. Next, additional drilling and field and laboratory testing was conducted to develop more realistic values of shear strength, and allowable bearing and sliding coefficients for the foundation materials.

RAPID DETERMINATION OF CALCIUM AND MAGNESIUM IN
CARBONATE ROCKS

David S. Haglund, *Virginia Council of Highway Investigation and Research*

6. A rapid method of determining calcium and magnesium in carbonate rocks is presented in lieu of standard gravimetric procedures. EDTA, an organic chelating agent (Ethylenediaminetetraacetic acid) selectively complexes calcium and magnesium at different pH ranges, thus lending itself to an accurate volumetric method of analysis. The analysis consists of two titrations, whose end points are determined by a color change of pink to violet due to a murexide indicator. The advantages over gravimetric methods are the reduced laboratory time which becomes appreciably decreased in mass analysis, and the ease and simplicity of analysis.

NEW EOCENE DEPOSITS IN THE RICHMOND, VIRGINIA AREA

W. T. Parrott, *Virginia Department of Highways*

1. Additional explorations for the foundation of the new annex of the Virginia State Highway Department building in Richmond, Virginia, encountered two deposits of hitherto unreported materials.

The additional exploratory work consisted of four holes, all of which terminated in the Petersburg Granite of Pre-Cambrian age. This granite was found between elevations $+8'$ and $-2'$.

A great unconformity exists between the granite and the next deposit which is a fine-grained, dense, green siltstone. Core drilling shows that siltstone ranges from $2'$ to $6'$ deep. The mineral content as disclosed by x-ray diffraction shows the presence of glauconite, quartz, illite, montmorillonite and magnitite. Its lateral extent is undetermined.

Immediately overlying this siltstone is a conglomerate. The gravels and cobbles are composed of the usual rounded fragments of igneous and metamorphic rock, that is quartzite, sandstone, schist, diabase and granite. The lateral extent of this deposit is also undetermined.

Due to the stratigraphic relation and the pronounced presence of the mineral glauconite, it is believed that these deposits are of Eocene age. No fossils were found in either deposit.

A search of the literature gives no reference to siltstone and conglomerate in the Eocene of the Richmond, Virginia, area.

MINERALOGY OF SOME VIRGINIA CARBONATE ROCKS

C. S. Sherwood, *Virginia Council of Highway Investigation and Research*

7. Laboratory data obtained from 224 carbonate rock samples from 41 quarries located in the Appalachian Valley of Virginia provide the basis for the observations and trends noted in this work. This suite of samples are dominantly Cambrian and Ordovician in age and are not meant to serve as a representative sample of all of the carbonate rocks exposed in the state.

Work on the rock samples included calcite/dolomite ratios, insoluble residue contents, thin section studies and X-ray identification of clays. The following points of interest evolved from tabulating and comparing the information obtained:

1. Most of the 224 rocks analysed were composed dominantly of either calcite or dolomite, rather than near-equal mixtures of the two. 2. A plot of number of samples vs. insoluble residue percent showed the greatest number of samples at less than 5 percent insol, and progressively smaller numbers of samples in each group as insols increased in 5 percent increments. 3. Rocks of intermediate mixtures of calcite and dolomite contained more insoluble material than rocks composed dominantly of either calcite or dolomite. 4. Dolomites were coarser grained than limestones and showed few original sedimentary features. 5. Clays occurring in all of the 8 samples X-rayed included illite and chlorite.

SHEAFLIKE BARITE FROM NEW RAYMER, COLORADO

William E. Workman, *University of Virginia*

9. Sheaflike barite near New Raymer, Colorado was first noted by R. S. Mitchell in 1960. In 1962, the author visited this locality which is 2½ miles east and 1½ miles north of New Raymer in Weld County. The barite sheaves, from 1 to 4 centimeters long, occur in white to tan massive clays of the White River formation, which is exposed in a blow-out, a common erosional feature of Northeastern Colorado.

The crystals are elongated parallel to the *b* crystallographic axis, and the divergings of the sheaf are in the plane containing the *b* and *c* axes. The specimens appear to be made up of individual crystals which show the greatest orientation discrepancies on the outer edges of the sheaf, and the least near the center. Optical investigation reveals that the sheaves are essentially single crystals which display extreme wavy extinction characteristics, and that simple crystal intergrowths and twinning are absent. X-ray powder photographs reveal no structural variation d

to isomorphous substitution. The results of spectrographic analyses suggest that a direct relationship exists between the sheaf-angle (measured from the *b*-axis to the last sheaf unit: ranging from 6 to 45 degrees) and the amount of incorporated silica: the greater the sheaf-angle, the greater the amount of silica present.

The concepts proposed by Zwicky, Davey and Buerger regarding surface tension cracks, impurities and lineages provide a reasonable explanation for this sheaflike development.

This represents one of over one hundred barite localities presently under investigation by the author.

SECTION OF MEDICAL SCIENCES

L. A. Mounter, *Chairman*

J. A. Thomas, *Secretary*

W. P. Anslow Jr., *Section Editor*

MINUTES

The meeting was called to order Friday, May 3, 1963 at 3:00 P.M. The possibility of holding a two day session in future meetings was discussed. Officers elected for next years meeting are: *Chairman*, J. A. Thomas, University of Virginia; *Secretary*, M. S. Rittenburg, Medical College of Virginia; *Section Editor*, W. P. Anslow, Jr., University of Virginia; *Historian*, C. L. Gemmill, University of Virginia.

John A. Thomas, *Secretary*

LASTING EFFECTS OF LOW DOSE X-IRRADIATION ON THE LENS OF THE MAMMALIAN EYE

Edward R. Berry and E. Raymond Berry, *Medical College of Virginia*

6. Rabbit eyes were exposed to varying dosages of x-ray from 1,000r to 25r. In each rabbit only one eye was irradiated, the other eye serving as control. After one year the animals were sacrificed, the lens removed and quick frozen in a cryostat. By means of micro dissection the lenses were divided into a peripheral fraction, anterior capsule, posterior capsule, cortex and nucleus. The weighed samples were homogenized in water and electrophoresis was performed by the method of Wieme.

The lens showed an effect of x-rays in two major areas: The peripheral or equatorial tissue increases the protein concentration in the gamma region, but in the nucleus there is a decrease in the alpha-2 beta protein region. The effect was discernible down to and including the 25r level, where the change was only in the order of 5-10% of the total area. (Supported by grants from the Atomic Energy Commission and the Defense Atomic Support Agency).

NICOTINE ABSORPTION FROM THE URINARY BLADDER

Joseph F. Borzelleca, *Dept. of Pharmacology, Medical College of Virginia*

1. Nicotine is absorbed from the intact urinary bladder of the rat and dog. This absorption is influenced by the concentration, pH and volume of the solution instilled and the condition of the bladder mucosa. Studies to determine the nature of this transfer process were conducted with the isolated urinary bladder of the rabbit. Nicotine transfer was influenced by the pH of the solution but not by the concentration of the solution, pretreatment with metabolic inhibitors, refrigeration for 1 week, or the presence of (-)-cotinine. These findings suggest a passive movement of nicotine from the urinary bladder. (Supported by USPHS Grant No. RG-7064).

ALTERATIONS OF SOLUBLE RETINAL PROTEINS IN THERMAL INJURY

Guy Chan, E. R. Berry and W. J. Geeraets, *Medical College of Virginia*

11. The effect of thermal injury on retinal proteins was studied. A light coagulator, designed to regulate time exposures and energy output, was used to produce two types of retinal burn. (Short exposure at 175 μ s, 0.280 cal./cm²) (Long exposure at 500 ms, 3.55 cal./cm²).

The center of the burn and the adjacent retinal areas were examined by micro agar electrophoresis by Wieme and recorded by means of a special micro spectro-photo-densitometer. The patterns of normal retinal proteins were compared with that of the light coagulated samples of both short and long exposures. Greater loss of soluble retinal proteins was found in the sample coagulated with the long exposure. Lesser loss was seen in the sample from the short exposure. Variations in response to thermal effect was noted in albumen, beta and gamma globulins. Albumen and beta globulin were more susceptible to heat than the gamma globulin. The effect of thermal injury was found to extend radially more than 2 mm from the center of the burn. The observed progressive decrease in thermal effect toward the periphery is due to heat conduction.

THE GAS CHROMATOGRAPHY OF THE MAJOR FATTY ACIDS IN SERUM
LIPID FRACTIONS

W. T. Dabney and C. W. Chamberlain, *Medical College of Virginia*

10. Venous blood samples were donated after breakfast by 15 healthy men and 15 healthy women (ages 21-44). The total lipid from 10 ml. of the sera was extracted and then separated on silicic acid columns into cholesterol ester, triglyceride and phospholipid fractions. The methyl esters of the fatty acids in each fraction were prepared and analyzed by gas liquid phase chromatography. The total cholesterol, total phospholipid and total lipid were compared between men and women and revealed no significant difference. A comparison between the 15 men and the 15 women with regard to the relative amounts of the principal fatty acids in the major serum lipid fractions revealed significant differences in the cholesterol ester and phospholipid fractions. In particular the mean per cent linoleic acid in the cholesterol ester fraction was greater in the young women than in the young men.

ENZYMoeLECTROPHORETIC TECHNIQUES APPLIED TO A STUDY OF
SERUM ENZYME INHIBITORS

Phyllis M. Darden and M. S. Rittenbury, *Medical College of Virginia*

27. A modification of the micro agar gel electrophoretic method of Wieme has been used to both localize and quantitate effects of both proteolytic enzymes and inhibitors in human serum. The agar contains .05% casein as a substrate, and after routine electrophoresis of the sample it is then incubated at 37° C. for 20 minutes, fixed with acetic acid, stained with Amido Schwartz, and traced on a microdensitometer, (Model WRB, Mk. 1c).

The effect of normal serum trypsin inhibitors has been studied by adding different amounts of enzyme to serum, incubating for 15 minutes, and then following the above procedure. Lesser amounts of added trypsin are completely inhibited, although the electrophoretic peak for the beta-2 globulin disappears. When sufficient trypsin is added to overcome the inhibitory capacity of the serum activity first appears in the beta-0 globulin area, and when other increments are used this activity gradually appears in the rest of the beta globulin region of the electrophoretic pattern, then in the alpha region, and lastly in the gamma globulin region. With direct quantitation of the changes in the protein content and the enzyme activity within these areas it can be shown that the albumins, alpha-1 globulins, and gamma globulins are the least affected.

A non-caseinolytic protein band appears in the alpha globulin region when the inhibitors have been overcome with sufficient added trypsin, and the density of this band increases when further increments of trypsin are added to the serum.

Using this technique there is no evidence for the formation of the protective alpha-2 globulin-trypsin complex postulated by Haverback, Mehl, and others. Activity present in these patterns can be completely inhibited by adding soybean trypsin inhibitor after enzyme-serum incubation is complete. (Supported in part by funds from the National Institutes of Health Research Grant AM-03517, USPHS.)

THE SODIUM AND POTASSIUM CONTENT OF ADIPOSE TISSUE AND THE EFFECT OF INSULIN

M. B. Davidson and D. R. H. Gourley, *University of Virginia School
of Medicine*

19. K, Na and water content of epididymal adipose tissue of young rats decreases as the rat weight increases. In adipose tissue from 97-171 gm Holtzman rats, the mean concentration per gram of initial weight is: 14.5 μ Eq K, 19.6 μ Eq Na, 223 mg water. When incubated 3 hours at 37° C in Krebs-Ringer bicarbonate solution, isolated fat bodies from 89-145 gm rats gain water and Na but lose K. Addition of 8.5 mM glucose significantly reduces K loss. Insulin (50 mU/ml) added to Krebs-Ringer-Glucose solution significantly reduces K loss and Na gain by 11%. These effects are in the direction predicted from previous electrolyte studies and from application of the membrane potential theory.

CARDIOPULMONARY FUNCTION DURING ACUTELY INDUCED HYPERTENSIA IN ANESTHETIZED DOGS

R. K. Davis, J. W. Longacher, Jr., W. M. Davis, W. J. Wooddell,

C. M. Banerjee and S. I. Said, *Medical College of Virginia*

5. Acute severe hypertension, leading to death from pulmonary edema, was produced in anesthetized dogs by the intravenous infusion of 6% dextran in saline, at the rate of approximately 4 ml/min/kg. Left atrial pressure rose to a peak (about 70 mm Hg) and then declined. Mean pulmonary arterial pressure changed similarly. As these pressures decreased, the systemic arterial pressure and cardiac output were falling, although left ventricular end-diastolic pressure continued to rise. Arterial blood oxygen tension remained normal until frank edema, and then it fell. Its fall was precipitous, reversible by forcible inflation of the lungs,

and could be accounted for entirely by an increase in venous admixture, thus suggesting alveolar closure. Morphologic examination confirmed the presence of atelectatic areas. Saline extracts from these areas showed consistently higher minimum surface tension on the surface balance than extracts from the remainder of the lung ($p < .001$). Increased surface tension, along with reduced diameter of fluid-filled alveoli, probably contributed to alveolar closure in pulmonary edema.

FURTHER STUDIES ON THE DISTRIBUTION OF CHOLESTEROL IN SERUM

J. C. Forbes and O. M. Petterson, *Medical College of Virginia*

4. The possible significance of hypercholesterolemia and/or hypertriglyceridemia in the development of atherosclerosis in man has received considerable emphasis over the years. Attempts have been made to fractionate the serum lipids in various ways in the hope that a particular lipid fraction could be obtained which would correlate better with the presence or absence of atherosclerosis than total serum cholesterol but none have proved very satisfactory. Studies on the changes in serum cholesterol and triglyceride concentrations which one may expect in male and female subjects in this part of the world will be presented, as well as their concentration in the infranate following centrifugation of serum at $20,000 \times g$ for 2 hours at $4-5^{\circ}C$. The results showed a definite rise of both constituents with age in each sex. For example, normal males 41-50 years of age showed 44 per cent with hypercholesterolemia (concentration over 275 mg/100 ml) as against 6 per cent for young men 17-25 years of age. Young women tended to have slightly lower concentration of both lipid fractions than young men, but markedly elevated concentrations appeared later in life. Women over 50 years of age tended to have higher serum cholesterol concentrations than males of comparable age, but the triglycerides tended to remain somewhat lower. Removal of the chylomicrons by centrifugation at $20,000 \times g$ and determination of cholesterol and triglycerides in the infranate showed no special advantage over serum analysis as far as separating normals from subjects with coronary artery disease was concerned.

THE INHERITANCE OF ANOPHTHALMIA IN THE SYRIAN HAMSTER

R. D. Hughes, W. J. Geeraets and M. D. Berman, *Medical College of Virginia*

15. The anophthalmic, or extreme microphthalmic gene (Wh), is an autosomal recessive with respect to eye development. The heterozygote causes a white venter and pigment changes in choroid coat. The pelage of the homozygote is devoid of pigment and the eye markedly reduced,

or virtually absent. Anomalous development of the eye can be detected at about 13½ days of gestation. Another gene that arose spontaneously in a fancier's colony causes partial microphthalmia. This gene tentatively designated (M) is not an allele of (Wh).

THE USE OF THE ERG TO DETECT FUNCTIONAL THERMAL INJURY TO THE RETINA

W. J. Geeraets, K. McNeer and M. Ghosh, *Medical College of Virginia*

21. It has been attempted to use the electroretinogram as a means of measuring functional change in the rabbit retina following exposures to light energy of uniform photon density. ERG measurements have been performed on retinas exposed to energy levels resulting in visible "threshold" thermal lesions and on retinas exposed to energy levels, reduced in 10 percent steps, below the threshold value. Reduced B-wave amplitude was demonstrable in all instances after exposures as low as 50 percent below energy levels required for visible threshold lesion. This finding persisted over an examination time of two months after exposures.

THE METABOLISM OF RATS UNDER VARIOUS CONDITIONS

C. L. Gemmill and K. M. Browning, *University of Virginia School of
Medicine*

29. During the course of investigation of the activity of compounds comparable to thyroxine many determinations of basal metabolism have been made on rats under various conditions. The rats were white male rats obtained chiefly from Carworth Farms. The metabolism of 435 normal rats had an average and standard deviation of 34.4 ± 3.7 Calories per square meter of body surface per hour while for 299 thyroidectomized rats it was 21.5 ± 2.8 . Normal rats (53) given 20 to 26 micrograms of 3,5,3'-triiodo-L-thyronine (T-3) in 100 ml. of their drinking water had an average metabolism of 53.9 Calories. Using 30 to 40 micrograms of T-3 raised this average value to 60.1 Calories (95 rats). Thyroidectomized rats (32) receiving from 12 to 40 micrograms of T-3 in their drinking water had an average metabolism of 40.0 Calories. Normal rats (26) receiving 8 mgm. of methimazole in 100 ml. of drinking water had an average metabolism of 28.3 Calories. Hypophysectomized rats (33) had an average metabolism of 20.2 Calories.

THE USE OF INSULIN AND OUABAIN TO ELUCIDATE THE MECHANISM OF POTASSIUM EXCHANGE IN MUSCLE

D. R. H. Gourley, *University of Virginia School of Medicine*

18. Potassium ions probably leak out of muscle fibers by passive diffusion whereas the influx of K against a concentration gradient requires the expenditure of energy and is probably carrier-mediated. K influx is decreased by ouabain and increased by insulin but, as expected, neither drug influences K efflux. Ouabain acts by competing with K for the carrier (X) while insulin apparently acts by modifying the fiber membrane so that the combination of K with X is enhanced. When both ouabain and insulin are present together, the insulin modification of the membrane allows ouabain to complex more of the free X and greater inhibition of K influx is achieved.

COMPARATIVE STUDY OF AGING AND IONIZING RADIATION ON THE RABBIT

LENS

W. T. Ham, Jr., W. J. Geeraets, H. A. Mueller, R. C. Williams,
F. H. Schmidt, R. S. Ruffin, M. E. Turner, D. Guerry, III, and
R. Maddox, *Medical College of Virginia*

26. Similarities between biological aging and the effects of ionizing radiation in mammals have led some radiobiologists to postulate a casual relationship between these two phenomena. The theoretical implications of this hypothesis are far reaching and involve a basic understanding of radiation damage in living systems. Unfortunately, little quantitative data are available to examine the validity of this concept, and this is why the present study was undertaken. The mammalian lens was chosen because it is observable *in vivo* throughout life, is known to undergo certain changes with age (accommodation, color sensitivity, senile cataract), and demonstrates a well studied radiation effect (radiation cataract).

A total of 538 rabbit eyes, 6-10 weeks of age, were studied before the actual investigation began. One hundred twenty male Dutch rabbits, 8-10 weeks of age and carefully screened for lens anomalies, were chosen finally for this study. These animals were divided into six equal groups in a carefully planned statistical pattern designed to obtain the maximum amount of information. A well collimated beam of 1 Mev x-rays was used to expose the eyes of each group to doses of (0, 200), (0, 600), (0, 1000), (200, 600), (200, 1000), (600, 1000) r respectively. Four animals in each group of 20 were sacrificed at time of irradiation (8-10 weeks of age) and at six months intervals thereafter, until the group was finally depleted at the age of two years.

The relationship, if any, between ionizing radiation exposure and aging will be discussed in the light of physical data involving the mass, volume, density, hardness, and light transmission of the rabbit lens, and in terms of the clinical findings with the slit lamp. Current data indicate that changes in the physical properties of the lens seem primarily dependent upon age, whereas clinical findings seem most affected by radiation dose and method of exposure. Chemical changes in the lens proteins are detectable after exposure to 200r. In general, the data do not seem to support the hypothesis that there is a well defined relationship between radiation damage and aging in the rabbit lens. (Supported under AEC Grant, AT-40-1, 2452).

AN IMPROVED METHOD FOR ENZYME AMIDASE ASSAY

J. Harris, M. S. Rittenbury, and L. Mounter, *Medical College of Virginia*

13. Various authors have reported upon the amidase enzyme activity for proteolytic enzymes using specific amino acid amide substrates, but the methods used were complex, time-consuming, and poorly reproducible. The present method was evolved in an effort to circumvent these disadvantages, obtain a method that could be easily adapted to a clinical laboratory, and be applied to studies of different enzymes by changing the enzyme-substrate complex.

The unknown sample (or enzyme), substrate, and appropriate buffer are placed in customized flasks (Kontes Glass Co.), and they are rotated in a water-bath at 37° C. for 1 hour. BAA is the substrate for trypsin, while BTA is used for chymotrypsin. The pH of the reaction mixture is 8.0 for trypsin and 7.8 for chymotrypsin. After rotation for one hour .2 cc. of a saturated solution of potassium carbonate is added to raise the pH to 11.5. The ammonia released by enzymatic hydrolysis of the substrate is then diffused from solution and absorbed with 1 N sulfuric acid during a second hour of rotation. After color development with phenol, Chloramine-T, and manganous chloride the optical density of the color solution is determined at 640 mu. The change in the optical density is proportional to the amount of enzyme activity present within the original sample.

The optimal pH ranges, the rotation times, the effects of temperature and reagent age, and the amount of spontaneous substrate hydrolysis at these pH levels, and reproducibility using both standard solutions of ammonium chloride and enzyme-substrate mixtures have been determined, and the latter is satisfactory. (Supported in part by funds from National Institutes of Health Research Grant A-03517, U. S. Public Health Service.)

INDUCED ALTERATIONS IN CARBOHYDRATE METABOLISM

IN *Aspergillus niger*

Edwin S. Higgins and Wilbur G. Chambers, *Medical College of Virginia*

3. The process in microorganisms of induction by, or adaptation to, an exogenous compound has led to considerable knowledge in specific areas of intracellular metabolism. A strain of *A. niger*, resistant to the fungistatic action of *m*-dinitrobenzene, was isolated from cultures of the wild type. The resistant strain contained about 9%, on a dry weight basis, of a new polysaccharide which was isolated and characterized as a β -1,4 glucan. Whereas the wild type is an aerobic organism, metabolizing exogenous glucose predominantly to gluconate, the new strain promotes glycolysis instead of the gluconate pathway, and it is capable of anaerobic fermentation. The new polysaccharide was used preferentially to glucose in the absence of nitroaryl compounds, but the presence of dinitrobenzene inhibited catabolism of the glucan and in this way may account for accumulation of this polysaccharide. (Supported by USPHS Grant No. AI-01889-06).

PROPIONYL HOLOCARBOXYLASE SYNTHESIS

S. C. Huang, D. P. Kosow, and M. D. Lane, *Virginia Polytechnic Institute*

24. A soluble enzyme system, isolated from livers of biotin deficient rats, catalyzes the ATP-dependent synthesis of propionyl holocarboxylase from d-biotin and propionyl apocarboxylase. This system has been resolved by alumina cy gel fractionation into two essential components (a) gel supernatant, which contains propionyl apocarboxylase and (b) gel eluate, which contains an enzyme which catalyzes the covalent bonding of d-biotin to propionyl apocarboxylase. The gel eluate has been further purified by $(\text{NH}_4)_2\text{SO}_4$ precipitation and cellulose-phosphate chromatography. An enzyme similar to the gel eluate enzyme has been isolated from cell-free extracts of *Propionibacterium shermanii*. Although cell-free extracts of *P. shermanii* do not contain propionyl apo- or holocarboxylase, they do catalyze ATP-dependent propionyl holocarboxylase formation from d-biotin and rat liver propionyl apocarboxylase. Biotin-2'- C^{14} -labeled propionyl holocarboxylase, synthesized with these enzyme systems, does not transfer C^{14}O_2 to propionyl-CoA indicating that the ureido carbon of enzyme-bound biotin is not the "active" carbon of biotin.

HYPERBARIA IN CARDIOVASCULAR RESEARCH

Theodore George and George Margolis, *Medical College of Virginia*

23. Oxygen at high pressure (OHP) has been shown to be of consider-

able therapeutic value in the clinical management of a variety of local or generalized anoxic conditions, certain anaerobic infections and the radiotherapy of cancer. In addition, it has been demonstrated experimentally that OHP can be employed effectively in the treatment of cyanide poisoning and hemorrhagic shock, in the radiotherapy and chemotherapy of tumors, and in maintaining normal physiologic function in animals depleted of hemoglobin. Preliminary studies at this laboratory have shown that exposure of dogs to pure oxygen at pressure of 3 atmospheres substantially reduced the extent of spinal cord damage induced by the intra-aortic administration of Na acetrizoate (Urokon). It is our opinion that the protective action of OHP is probably brought about by the supply of abundant dissolved oxygen to the marginal area of the focus of acute circulatory insufficiency that results following the vasotoxic effect of Urokon, so that this area is being maintained viable until a proper collateral circulation is established. In view of the above mentioned therapeutic potentials of OHP, and the great clinical need for safer and better methods, especially in the field of cardiovascular surgery, hyperbaric research in the following areas of exploration is advocated: (1) the possible use of OHP as an adjunct to open-heart and brain surgery, and in effecting a reduction in the size of a myocardial or brain infarct; (2) the study of the influence of OHP on the healing processes of the body, and (3) the study of possible synergistic effect of OHP and antibiotics or cancer chemotherapeutic agents.

REACTIVATION OF PROTEASES INHIBITED WITH ORGANOPHOSPHORUS COMPOUNDS

L. A. Mounter and M. E. Mounter, *Medical College of Virginia*

30. The reactivation of α -chymotrypsin inhibited with diethyl- and di-1-butyl phosphorofluoridate has been studied. Hydroxylamine, pyridine-2-aldoxime and pyridine-2-aldoxime methiodide produce significant reactivation. Bimolecular rate constants for the reaction have been determined, and the value for pyridine-2-aldoxime is 20 times that of hydroxylamine. Di-1-butyl phosphorylated chymotrypsin is more rapidly reactivated than the corresponding diethyl derivative. Similar results were obtained with organophosphate-inhibited trypsin. Di-1-butyl phosphoryl trypsin was prepared from different organophosphorus compounds and the course of reactivation of each derivative was found to be identical. (This investigation was supported by Public Health Service Research Grant CA-03652 from the National Cancer Institutes).

EFFECTS OF X-IRRADIATION OF BOVINE ERYTHROCYTE CHOLINESTERASE

L. A. Mounter, *Medical College of Virginia*

22. The specificity of bovine erythrocyte cholinesterase has been shown to be very similar to that of other acetylcholinesterases (Whittaker, V. P., *Biochem. J.*, 54, 660 (1953)). A number of choline, and non-choline aliphatic esters and aromatic esters are hydrolyzed. The maximal rates of hydrolysis of aliphatic esters increase with the approach to the configuration of acetylcholine and the carbon analogue of this ester, 3,3-dimethylbutyl acetate, is very rapidly hydrolyzed. Dilute aqueous solutions of the enzyme were also subjected to X-irradiation and specificity and kinetic studies made upon the irradiated enzyme. The results indicate that the enzyme can have properties altered by X-irradiation, but that the active center may remain functional after irradiation damage. (This investigation was supported in whole by Public Health Service Research Grant CA-03652 from the National Cancer Institute).

DRUG INDUCED CHANGES IN THE CNS RESPONSE TO IONIZED RADIATION

J. L. Oliver and R. H. Brownson, *Medical College of Virginia*

16. This study was undertaken to determine whether several radio-protective drugs found effective in whole body experiments would also be useful in altering acute response of the CNS to ionizing radiation. One hundred and forty-six female albino rats, 30 days old, received injection of nembutal, cysteine, AET, MEA or serotonin immediately before exposure to 5,000 r irradiation. Groups of 3 animals were sacrificed at 1, 6, 12, 24, 48 and 72 hours following irradiation. Tissues were stained with Hortege's silver carbonate, Feulgen-fast green, PAB-hematoxylin and toluidine blue. Response to radiation was measured by quantitative determination of the numbers of altered oligodendroglis in the cerebellar molecular layer.

In animals subjected to radiation alone, the maximum number of altered cells was observed after 6 hours. In animals pretreated with either serotonin, nembutal or MEA, the maximum effect of irradiation was also observed in 6 hours, but the total number of altered cells was greater. In animals given ABT or cysteine the maximum increase in altered glial cells was observed at 24 hours. Further experiments on the effects of cysteine have been performed and are currently being evaluated. (Supported by grants-in-aid from the National Institute of Neurological Diseases and Blindness, No. B-1289; U. S. Atomic Energy Commission, No. AT-(40-L)-2904; and A. D. Williams Foundation).

THE DYNAMIC RELATIONSHIPS BETWEEN BODY FAT AND EXERCISE AND THE
FAT-FREE PORTION OF THE BODY

Grover C. Pitts, *University of Virginia*

9. In considering the body weight of man and other mammals the body may be separated into the two major subdivisions: fat and the fat-free body which includes skin, muscle, bone, glands, and viscera. The fat portion is known to be highly variable both in a population and from time to time within the life of an individual. However, the weight of the fat-free body has been regarded heretofore as relatively constant in individuals on an adequate diet, and largely fixed by genetic factors.

In studies on guinea pigs, some of which were on a relatively severe exercise regimen throughout their period of growth and others, sedentary, the weight of the fat-free body was found to depend both on how fat the animal was and how active he was. Since muscle and bone were the components of the fat-free body which changed most, the well-known ability of these tissues to hypertrophy was probably the mechanism involved. These results suggest that while an individual inherits certain bodily dimensions and ratios between dimensions, the weight of his fat-free body may be largely determined by the physical stress in his daily life. This would reflect a) the distance covered during an average day's activity and b) the weight carried, whether that weight be fat, muscle, bone or a load of bricks. An individual may inherit a "tendency" toward muscularity, for example, but how nearly he achieves his potential in this respect may be determined by his activity habits.

THE INFLUENCE OF PROSTATIC CARCINOMA ON THE ISOZYMES OF SERUM
LACTIC DEHYDROGENASE (LDH)

G. R. Prout Jr., L. J. Denis, and E. V. Macalalag Jr., *Medical College of Virginia*

7. Total lactic dehydrogenase and the isozymes of LDH in the serum of patients with prostatic carcinoma was determined. Total serum LDH levels were "borderline" or elevated in these patients, regardless of the status of the disease. When the isozymes of LDH were measured, IV and V were consistently elevated in the patients with advanced, progressive prostatic carcinoma, whether the patients had been treated or not. In those patients with prostatic carcinoma in remission. LDH IV and LDH V were at trace levels, consistent with findings in a control group of patients with miscellaneous diseases. No quantitative relationship between LDH IV, LDH V and elevated levels of serum acid phosphatase

could be demonstrated. The marked elevation of LDH IV and LDH V may be representative of the biological activity within the tumor and no claim is made that these alterations are specific for prostatic carcinoma.

HEPATIC *Delta*-AMINOLEVULINIC ACID (ALA) SYNTHESIS

R. A. Rudolph, Jr., D. E. Markow and L. D. Abbott, Jr., *Medical College of Virginia*

2. Excretion of *delta*-aminolevulinic acid (ALA) and porphobilinogen in experimental porphyria may be due to increased synthesis of ALA in the liver. Protoporphyrin and coproporphyrin synthesis in liver slices from rats receiving allylisopropylacetylcarbamide (Sedormid or 3,5-dicarbethoxy, 1,4-dihydrocollidine (DDC) was measured after incubation with glycine. Normal liver slices produce little or no coproporphyrin or protoporphyrin under the conditions used but produced large amounts on incubation with ALA. Two hours after intraperitoneal administration of DDC the hepatic level of coproporphyrin and protoporphyrin was within normal limits, but liver slices were capable of *in vitro* porphyrin synthesis which was stimulated by glycine 3 to 5 fold.

THE EFFECT OF SEVERAL STEROIDAL AGENTS ON LIVER PHOSPHORYLASE ACTIVITY

J. A. Thomas, *University of Virginia*

32. Fresh liver homogenates obtained from male albino mice previously treated with norethandrolone, norethynodrel, ethisterone, cortisone or testosterone (2.0 mg/kg) were assayed for phosphorylase activity and liver glycogen. Norethandrolone administered in a dose of 0.5 mg/kg did not influence hepatic phosphorylase, but 1.0 mg/kg caused a 21% decrease in enzymatic activity. One hour following injection (2.0 mg/kg), norethandrolone groups and norethynodrel groups exhibited significant reduction in liver phosphorylase ($P \leq 0.01\%$). Liver glycogen was diminished about 30% in each instance. Testosterone and ethisterone (2.0 mg/kg) caused enhanced liver enzymatic activity, but showed little influence on hepatic glycogen. Cortisone increased liver glycogen ($P \leq 0.01\%$) but did not alter phosphorylase activity.

SECTION OF MICROBIOLOGY

Grace J. Blank, *Chairman*Lilla C. Rucker, *Vice Chairman*Gerald Goldstein, *Secretary-Treasurer*P. A. Hansen, *Section Editor*

MINUTES

The annual meeting of the Virginia Branch of the American Society for Microbiology was held on May 3, 1963. The following slate of officers was elected to take office on May 4, 1963: *President*, Gerald Goldstein, University of Virginia; *Vice President*, Abe Rosensweig, Veterans Administration Hospital, Richmond; *Secretary-Treasurer*, Robert W. Tankersley, Jr., Medical College of Virginia; *Council Representative*, P. Arne Hansen, University of Maryland.

GENETIC AND ENZYMATIC STUDIES WITH IDENTICAL SITE L-ARABINOSE

MUTANTS OF *Escherichia coli* B/R

Richard M. Cribbs, *Department of Biology and Genetics, Medical College of Virginia*

2. L-arabinose non-utilizing (*ara*⁻) mutants of *E. coli* that fail to recombine to prototrophy in transduction experiments with phage Plbt are considered to be at the same site on the chromosome. Certain "identical site" *ara*⁻ mutants, however, have been shown to differ in their recombinational properties and also show quantitative differences in enzyme activity. These identical site mutants were further tested by comparing their response (induction of *ara*⁻ → *ara*⁺) to the chemical mutagens diethyl sulfate, β-propiolactone, 2-aminopurine and 5-bromodeoxyuridine. Three different pairs of identical site mutants were tested. Each mutant of one identical site pair (*ara*-22 and *ara*-26) responded similarly to all four mutagens. *Ara*-28 was induced to *ara*⁺ by all four mutagens while *ara*-16, at the same site, was not induced by any of the chemicals. *Ara*-15 and *ara*-62 showed a similar response to the alkylating agents but differed in their response to the base analogs.

These results suggest that two *ara*-mutants, while at the same site on the chromosome, may differ in their type of mutational change.

THE MECHANISM OF INDUCTION OF CONTACT TYPE HYPERSENSITIVITY

Eugene R. Heise, *Department of Microbiology, University of Virginia School of Medicine*

4. Experiments were designed to determine whether the role of skin in contact type hypersensitivity could be due to (1) presence of a suitable carrier protein for conjugation and/or (2) an adjuvant effect.

The minimal dose of picryl chloride and picryl-guinea pig albumin conjugate required to sensitize intraperitoneally was determined. When autologous guinea pig epidermis was added to a non-sensitizing dose of picryl chloride about one third of the animals became sensitized to picryl chloride. Addition of epidermis to the preconjugated picryl-albumin failed to increase sensitization.

Another experiment was performed to determine (1) effect of incorporation of the sensitizer-epidermis mixture in a water-in-oil emulsion and (2) ability of a non-cross reacting sensitizer (citraconic anhydride) to block reaction of picryl chloride and epidermis. The water-in-oil emulsion increased percent of animals sensitized by picryl-epidermis from 31% to 80%. Sensitization to picryl chloride was partially but not completely blocked by prior conjugation with citraconic anhydride. Picryl-albumin incorporated in emulsion failed to sensitize, but addition of epidermis resulted in sensitization of 80% of the guinea pigs. Pretreatment of the epidermis with citraconic anhydride blocked sensitization to picryl-albumin.

MEASUREMENT OF ANTODIES TO *E. coli* IN MAN

Calvin M. Kunin, *Department of Preventive Medicine, University of Virginia School of Medicine*

An investigation of the distribution of antibodies in man and animals to 11 different *E. coli* O antigen groups, including 6 groups commonly observed in urinary tract infections, revealed that:

1. The hemagglutination test is a highly specific and sensitive test for antibody in human serum and is more sensitive than the bacterial agglutination test.

2. Antibodies to all 11 groups are demonstrable in the serum of almost all subjects over the age of 2 years; the geometric mean titers gradually level off above this age. Antibody titers are generally higher in females than males, but differences observed are only rarely significant.

3. Girls who have had urinary tract infections in the past closely

resemble females of the same age in titer and variety of *E. coli* antibodies.

4. Transplacental transfer of *E. coli* antibodies occurs to some extent, but is relatively inefficient; the newborn has either low or undetectable titers.

These observations are discussed in relation to the overall problem of resistance to Gram-negative infections, to the problem of urinary tract infections, pyelonephritis, and the severe Gram-negative bacteremias not infrequently observed in newborns.

IDENTIFICATION OF *Pasteurella* SPECIES BY IMMUNOFLUORESCENCE

John D. Marshall and P. Arne Hansen, *Department of Microbiology, University of Maryland, College Park*

5. Immunofluorescence and bacteriological and histologic techniques were studied to determine the efficacy of the fluorescent antibody technique as a diagnostic tool. Cultures, clinical material and tissues obtained from animals infected with *Pasteurella anatipestifer*, *P. gallinarum*, *P. haemolytica*, *P. multocida*, *P. novicida*, *P. pestis*, *P. pseudotuberculosis*, and *P. tularensis* were examined.

Immunofluorescent techniques provided a rapid and reliable method for the identification of all species of *Pasteurella* studied, provided the material consisted of cultures, either pure or mixed, or untreated clinical material. A single recurring incidence of species cross-reaction was observed. Anti-serum prepared against either *P. pestis* or *P. pseudotuberculosis* reacted with strains of both; differentiation was possible when an antiserum against *P. pestis* Fraction I was substituted for *P. pestis* antiserum prepared against the whole organism.

When smears of pure cultures exposed one hour to absolute ethanol, 95% ethanol, 70% ethanol, absolute methanol, chloroform or 10% formalin were treated with specific antiserum, no alteration of staining characteristics was observed with 6 species. The standing reaction of *P. pestis* or *P. pseudotuberculosis* and their homologous antisera was diminished or completely destroyed by all reagents except absolute alcohol.

ALANINE DEHYDROGENASE AND SPORE GERMINATION

Neil G. McCormick, *Department of Microbiology, University of Virginia*

3. Spores of *Bacillus cereus*, strain T, obtained from sporulation in the presence of different amino acids, contain altered enzyme levels. Sporulation in the presence of L-alanine results in the production of spores containing increased levels of L-alanine dehydrogenase, an enzyme

which is involved in L-alanine induced germination. It appears that spores L-alanine dehydrogenase arises during the sporulation process. Although kinetic data and inhibitor studies indicate that vegetative cell enzyme is identical to spore enzyme, heat inactivation studies have shown that the enzyme extracted from late stationary phase vegetative cells possesses both a heat sensitive component and a heat resistant component. Spore enzyme, on the other hand, contains only a heat resistant enzyme.

It was further shown that the L-alanine induced germination rates of spores containing high levels of L-alanine dehydrogenase were much lower than those containing basal levels of enzyme. Studies attempting to correlate the germination rate with enzyme content have suggested that an enzyme other than L-alanine dehydrogenase may be rate limiting in the overall germination process, and furthermore, that this enzyme may be DPNH oxidase.

VITAMIN REQUIREMENTS OF *Listeria monocytogenes*

H. J. Welshimer, *Department of Microbiology, Medical College of Virginia*

1. The growth response of *Listeria monocytogenes* to various vitamins was determined in synthetic and semi-defined media. All strains tested failed to grow for more than one passage in the absence of any one of the following vitamins: riboflavin, biotin, thiamine and thioctic acid. The requirement for thioctic acid could be modified by increasing the thiamine concentration; however, thiamine could not be substituted for thioctic acid.

SECTION OF PSYCHOLOGY

R. A. Johnston, *Chairman*

E. Rae Harcum, *Secretary*

W. H. Hinton, *Historian*

W. H. Leftwich, *Section Editor*

MINUTES

The meeting was called to order at 3:45 p.m. by the Chairman, Dr. Robert A. Johnston. The minutes were read by the Secretary-Treasurer and approved as corrected. The treasurer's report was stated and approved. Balance in the treasury is \$4.10. Dr. Johnston reminded the session that the exhibitors at VAS essentially pay the convention expenses; he urged members to attend the exhibits.

Dr. Johnston reported that he had been in communication with Dr.

Edward Brayfield, concerning the Domestic Peace Corps, and asked the section to think about ways of cooperating with the Corps. The Corps would ask local people to match in volunteer-service time the effort of each Peace Corps member. For the time being, the communication was classified as information for the section, with no action necessary.

Dr. Johnston noted that Dr. Frederick H. Rowe had resigned as section editor of the *Virginia Journal of Science*. He notified the section that the Executive Committee had appointed Dr. William H. Leftwich to the position, and asked members to send news to him (P. O. Box 81, University of Richmond). Dr. Rowe also encouraged people to send news to the Section Editor, especially Department Chairmen to send notice of new appointments to their faculty.

Dr. Johnston reported on the new Psychology section of the Virginia Junior Academy of Science. Seven papers were read at the current meeting, with Drs. Hinton, Beck, and Johnston serving as judges.

Dr. Johnston reported on a study of high school instruction in Psychology in Virginia. He spoke of a need for such high school instruction. He reported results of a survey which found that fourteen high schools in the State of Virginia taught courses in psychology. The requirements for teachers of psychology in Virginia were discussed. To be included in the 24 hours required for teaching of psychology were Child Psychology, Developmental Psychology, and the like. Dr. Johnston also reported writing to the Boards of Education of 49 other states to obtain information concerning their high school instruction in psychology. In conclusion, Virginia compares favorably to other states in high school programs with respect to psychology courses taught. Thirty-seven publishing houses had been asked to recommend any texts they had for high school courses in psychology, and a large number of texts were on display at the meeting of the section. Chairman Johnston recommended that high school teachers be invited to join the Psychology Section of the Academy. Also, he recommended the addition of requirements for laboratory courses in the training for teachers of psychology in high school. Also he suggested that lists of psychologists who offer to give guidance to high school students with psychology projects should be given to teachers. The winner of the competition in the Psychology division of the Junior Academy of Science should be invited to present his paper to the Senior Academy on the Senior Academy program. Finally, Dr. Johnston suggested that the section establish a summer workshop for high school teachers of behavioral science (including psychology and biology).

Dr. Hinton moved that the current committee to study the program of high school instruction in psychology be continued. The motion was seconded by Dr. Williams, and was passed without dissent.

Dr. Williams moved that the best paper of the psychology section of the Junior Academy be read at the Senior Academy. Dr. Hinton seconded the motion, and it was passed without opposition.

Dr. Hinton, reporting as chairman of the Special Resolutions Committee, made the following motion:

The Psychology Section of the Virginia Academy of Science notes with deep regret the death of Gilbert J. Rich during the spring of this year.

As an active and loyal but constructively critical member of the Section, he contributed significantly to psychology in all its phases and to all related scientific and professional areas in Virginia and the nation. In Gil Rich, the Academy and the Psychology Section have lost a source of inspiration and wisdom and their members a loyal and esteemed friend.

Your committee moves that this resolution be spread upon the minutes of the Psychology Section and that a copy be sent to Mrs. Rich with our deepest sympathy.

Dr. Silverberg seconded the motion; it was passed by unanimous rising vote.

The Section decided to announce to the Junior Academy that high school members were invited to attend sessions of the Psychology Section of the Senior Academy.

The report of the nominating committee, composed of Drs. Williams, Hinton, and Johnston, was read. The nominations were: Dr. E. Rae Harcum, Chairman; Dr. Leonard Jarrard, Secretary-Treasurer; and Dr. L. Staling Reid, Executive-Committeeman. It was noted that the officers would normally stay in office for two years. Dr. McEwen moved the adoption of the committee report, and Dr. Grigg seconded the motion. The motion was passed without dissent.

Dr. Hinton reminded that representation on the Academy Council of the VAS was now staggered in tenure. Dr. Williams is presently the Council member. The present composition of the Council includes one member from each section, each elected for three-year terms.

The Chairman expressed appreciation to the retiring Secretary for the work of the year.

Dr. McEwen announced that the VPA social hour and dinner would be held that evening at 5:30 p.m. Dr. Jacob Silverberg would be the speaker.

Dr. Hinton moved that the meeting be adjourned; Dr. Williams sec-

ended the motion. The motion was passed, and the meeting adjourned at 4:49 p.m.

E. Rae Harcum, *Secretary-Treasurer*

RELATIONSHIPS AMONG MEASURES OF PERFORMANCE FOR PATIENTS DIAGNOSED AS HAVING ORGANIC BRAIN SYNDROME

John J. Baldino, *The College of William and Mary*

20. This study investigates the relationship among 4 measures of performance: The Bender-Gestalt test, Witkins Rod-in-Frame test, Witkins Embedded Figures test, and a fourth test of what was called textured targets. This test consisted of a series of slides on which were backgrounds of small black and white squares ordered such that 2 unlike squares had a 50% chance of following one another. In the center of half of the fields were targets composed of black and white alternating squares. There were 8 different targets used.

Of the twelve men hospital patients used, six had been diagnosed as having a chronic brain syndrome, and the other six were matched to the organics in terms of age and education.

The results showed no significant relationships between measures probably because of the small number. The Embedded Figures test and Rod-in-Frame test both significantly delineated between the organics and controls at the .01 level, however, these did not correlate. The Bender-Gestalt tests were subjected to a clinical sort and only one person was misplaced in each group. The textured targets did not differentiate at all between the two groups. This study needs to be replicated with larger groups.

EARLY RECOLLECTIONS AS INDICATORS OF PERSONALITY

R. Vernon Bess and Virgil V. McKenna, *The College of William and Mary*

21. In this study, we sought to determine whether, as Adler has suggested, personality styles would be revealed in Ss' earliest memories. The personality style investigated was field-dependence-independence (Witkin, *et. al.*, 1954; 1962).

A group form of the Embedded Figures Test (EFT) was administered to define the personality variable. Earliest recollections were scored by two independent judges for Ss' perception of parents as being supportive or non-supportive, according to a method developed by Witkin with the

T.A.T. Results clearly indicated that the two personality groups differed in their recollections: field-independent Ss recalling their parents in more supportive situations than field-dependent Ss.

The memories were also scored by two judges along three, nine-point, bipolar adjective scales. The scales were conceptually derived from Witkin's theory. Although scale values were consistently in the predicted direction, no significant difference between field-dependent and independent Ss were found.

Results of the supportive — non-supportive analysis were interpreted as indicating the usefulness of early recollections as indicators of personality variables and as increasing the generality of Witkin's findings. Various methodological difficulties were cited as possible reasons for the lack of predicted differences when scales were used.

A FURTHER STUDY OF THE EFFECTS OF REPETITION ON INTENSITY OF MEANING

Barbara E. Bryant and Virgil V. McKenna, *The College of William & Mary*

13. The reported experiments attempted to reproduce the satiation phenomenon reported by Lambert and Jakobovits (1960). This phenomenon, the loss of meaning as measured by change in polarity on the Semantic Differential following repetition of a word, is now in question.

Experiment I, using an altered method, showed no effect of the satiation procedure on frequency (popular or rare) of associations, mean polarity score changes, or changes of rating on "Meaning Scales." The association-latency measure showed a significant change ($p < .05$) in the experimental satiation group, in a direction opposite to that predicted.

Experiment II, an exact replication of the Lambert and Jakobovits (1960) study, still in progress, shows no significant changes, but there is a slight indication of a trend in the predicted direction.

THE PSYCHOLOGIST AS AN EXPERT WITNESS IN CRIMINAL CASES

Arthur Centor, *Southwestern State Hospital*

24. History of the insanity plea up to and including the M'Naghten rule is discussed. The application of this rule is presented along with the addition of "the irresistible impulse" rule by the clinical psychologist as applied in the State of Virginia with special reference to mental deficiency, obsessive-compulsive reaction, the brain syndromes, amnesia, epilepsy, alcoholism, schizophrenia, affective psychosis and sociopathy. The application is touched upon with reference to history, clinical interview and

test results. Attention is focused to questioning of the psychologist in the court room.

VISUAL ACUITY FOR LINE-GRATINGS AS A BIVARIATE FUNCTION OF RETINAL MERIDIAN AND LINE-ORIENTATION

Richard L. Cherry, *The College of William and Mary*

22. This study investigated the generality of results obtained in an earlier experiment on visual acuity for line-grating test-objects, by using a larger sample of Os. The line-grating test-objects were long narrow rectangular areas. Recognition accuracy for reporting the inclination of the lines was measured for different inclinations of the lines within the grating, when the rectangular area was presented along different meridians. Four inclinations of the lines and of the rectangular areas (0° , 45° , 90° , and 135° from horizontal) were studied.

The earlier study suggested that at least three variables other than width and separation of the test lines were important. Results indicate trends in the direction of the earlier study. The horizontal and vertical inclinations of the lines in the grating resulted in fewer errors of recognition than diagonal line-inclinations. Conversely, with respect to the meridians along which the rectangular gratings were presented, fewer errors were made along the diagonal meridians than the horizontal and vertical meridians. Greatest acuity occurred when the lines within the grating were parallel to the long axis of the rectangle, and poorest acuity was found when they were perpendicular to that axis.

PARENTAL IDENTIFICATION AND FIELD-DEPENDENCE-INDEPENDENCE

Thomas L. Coffman and Virgil V. McKenna, *The College of William & Mary*

22. This study investigated the relationship between parental identification and field-dependence-field-independence. Parental identification was measured by ratings of My Father, My Mother, and Myself on a semantic differential. Difference-scores between the ratings of Myself and each parent were computed for four groups of scales. Field-dependence-independence was measured by a group form of Embedded Figures Test. It was predicted that within each sex and in both sexes combined, father identifiers would be more field independent than mother identifiers. Sixty men and 53 women were tested.

No significant relationship was found between field independence and identification.

It was noted that reversals of identification occurred between different measures (groups of scales) for parental identification in many cases, emphasizing the necessity for improving selection of appropriate scales for the semantic differential. In one group of subjects who were also given the Guilford-Zimmerman masculinity-femininity scale, it was found that men who consistently identified with their fathers (on all identification scores) scored higher on masculinity than men who consistently identified with their mothers. This indicates some construct validity for the use of the semantic differential as a measuring instrument for parental identification.

THE EFFECT OF SHOCK INTENSITY ON INTRACRANIAL SELF-STIMULATION

William M. Durrett, *Washington and Lee University*

14. Five naive albino rats were given chronic electrode implantations in the medial forebrain bundle, an established center for reinforcement with electrical stimulation. The study attempted to determine if there existed an optimum value along the intensity continuum that could be generalized to any group of similar rats with chronic electrode implants in the same region of the brain. The parameters of frequency and duration of the stimulus were held constant throughout the study. If such a value of intensity could be found under the conditions of stimulus used, it would facilitate the use of intracranial reinforcement in further studies.

The parameter investigated in the experimental sessions was ordered on a Latin square design to avoid inter-trial effects. The rate of responding under each of the stimulus conditions was recorded, and the mean bar press rate for each stimulus condition was graphically presented for each subject and for the group. The results indicate that a maximal value of stimulation intensity exists around the region of three milliamperes. At a frequency of five thousand cycles per second and a duration of three tenths second, the general trend above and below the three milliampere level is a decrease in bar press response.

THE EFFECT OF PRIOR HISTORY OF DEPRIVATION UPON SUBSEQUENT CONSUMMATORY BEHAVIOR

Daniel Fallon, *University of Virginia*

17. Four groups of rats were given different conditions of 23-hr. cyclic deprivation over a 30 day period. One of two groups which were subjected to 15 days of cyclic food deprivation was allowed to recover for 15 days on a free feeding regimen. Similarly, one of two groups which were subjected to 15 days of water deprivation was allowed to recover for 15 days. A fifth group was maintained on a free feeding regimen

throughout the entire 30 days, and served as a control. At the conclusion of the 30 day deprivation history period, all animals were subjected to either 23-hr. cyclic food deprivation, or 23-hr. cyclic water deprivation, for three days.

Under food deprivation, both kind of prior deprivation and recency of prior deprivation led to differences in consummatory behavior. That is, a history of food deprivation led to greater eating. Food or water deprivation, if recent, led to greater drinking.

Under water deprivation, only recency of prior deprivation was important. That is, food or water deprivation, if recent, led to greater eating and drinking.

It was observed that rats regulated their intake so as to maintain a fairly constant ratio of food to food plus water under any given maintenance schedule.

TAPPING TIME AS A FUNCTION OF TENSION MODALITY AS INDUCED BY A HAND DYNAMOMETER

Rodger W. Fauber, *Washington and Lee University*

5. The purpose of this study was to determine the effect of induced tension on performance. We used a more complex tapping task than has previously been used, and the tension was induced by a hand dynamometer.

Nine male students were randomly assigned into three groups, with each subject squeezing three tension levels. Each tension level was a certain percentage of the maximum pull. A counterbalance was worked out in such a way that each tension level was pulled first, second, and third by one of the three groups. The subjects had no practice, and feedback was given. The task of each subject was to get as many hits as he could in a specific period of time, and the hits as well as the misses were recorded on electric counters.

An IBM 1620 computer was used to do an analysis of variance on the data. A separate analysis was done for the hits and one for the misses. With regard to the number of hits there was no significant increase or decrease, but the analysis of the misses revealed an increase in the number of misses with increases in the level of tension.

Our data does seem to comply with Meyer's hypothesis, which was the impetus for this study, that induced tension facilitates motor responses.

PERFORMANCE ON A MOTOR LEARNING TASK AS RELATED TO MAS SCORES

George A. Gescheider, John H. Wright, and William F. Battig, *University of Virginia*

19. The relationship between Manifest Anxiety Scores and Inverted printing of Roman upper case letters (easy task) and Greek letters (difficult task) was investigated. It was assumed that response competition was greater for the difficult task than for the easy task.

Twenty-five 30-sec. trials, each separated by a 30-sec. rest period, were administered to 78 male undergraduates (difficult task, $N = 40$; easy task, $N = 38$). The number of letters printed during each trial comprised the raw data.

Statistical analysis was performed on the data of the 10 subjects with the highest and the 10 with the lowest MAS scores for both easy and difficult tasks. Task difficulty was significant at the .001 level. The main effect of anxiety level failed to reach statistical significance. However, low anxious were superior performers to high anxious subjects on the easy task and on the difficult task high anxious subjects were superior to low anxious subjects. The task \times anxiety level interaction was significant at the .05 level. When the data from all subjects were considered, a negative correlation of $-.28$ was computed between performance measures and MAS scores for the easy task and a positive correlation of $.23$ for the difficult task.

It was concluded that results were diametrically opposed to predictions based on the Hull-Spence theory of generalized drive.

INFORMAL PAPER AND DISCUSSION ON "HYPNOSIS: MORAL OR IMMORAL?"

Bert A. Goldman, *Mary Washington College, Chairman*; Alvis W. Jeffries, *Western State Hospital*; Harding L. Thomas, *Culpeper, Va.*; and Hans H. Stroo, *Roanoke Guidance Center*.

7. The nature of hypnosis was discussed, along with advantages and dangers of its use. Also included was a discussion of the proper training for hypnotists, and legal and moral issues involved in the use of hypnosis.

THE EFFECTS OF BILATERAL STIMULATION OF THE HIPPOCAMPUS ON
PERSEVERATIVE NEURAL PROCESSES

John P. Harcourt, Jr., *Washington and Lee University*

15. The purpose of this study was to determine the effects of bilateral stimulation of the hippocampus on perseverative neural processes as indicated by acquisition of a learning problem.

Twenty-four male albino rats were divided into three equal groups. An experimental group of 8 Ss had electrodes implanted in the hippocampus. An operated control group of 8 Ss had electrodes implanted in the neocortex. A third group of 8 Ss served as unoperated controls. Each animal was given three trials per day for 16 days in a Lashley Maze Type III. Ten min. after each block of three trials the hippocampal and neocortical animals were each stimulated by a 15 sec. burst of 60 cycle sine wave at .25 volts.

Analysis of variance and tests for the difference between means required for the significance indicated that, under the conditons of this study, bilateral stimulation of the hippocampus has no apparent effect on the perseverative neural processes. Several suggestions were made for the improvement of the study.

THE TWO-DIMENSIONAL SPAN OF APPREHENSION

E. Rae Harcum and George Bassett, *The College of William and Mary*

11. A stimulus-template containing four linear arrays of black-outline circles on white paper was constructed so that the arrays passed horizontally, vertically or diagonally either way through a central (fixation) point. Patterns were formed by blacking in four of the circles. Four experimental conditions were employed: S: All filled elements appeared on the same linear array; C: All filled elements appeared at the same eccentricity; and 2-D: Filled elements were chosen randomly except that not more than two elements appeared on one eccentricity or on one straight array.

A recording sheet contained matrices similar to the stimulus. The O was required to blacken the circles corresponding to the filled circles in the tachistoscopically exposed pattern.

The Os tended to exhibit fewer errors above and to the left of the fixation point, with large variations among Os.

"DOGMATISM" vs. "RIGIDITY" IN PERCEPTUAL FUNCTIONING

David A. Hitt and Virgil V. McKenna, *The College of William and Mary*

23. Rokeach (1960) has proposed that dogmatism is related to synthetic perceptual functioning, while rigidity, a correlated variable, is related to analytic perceptual functioning. Furthermore, according to Rokeach, there should be no relationship between dogmatism and analytic functioning, nor between rigidity and synthetic functioning.

This experiment was designed to test part of this hypothesis. Dogmatism and rigidity scales were administered as part of a personality inventory to 54 Ss. A group form of the Embedded Figures Test (EFT) was given as a measure of analytic perception.

Results were in the opposite direction to Rokeach's hypothesis. When equated for dogmatism scores, Ss differing in rigidity did not differ on EFT. When equated on rigidity scale scores, Ss low on dogmatism showed superior performance on EFT when compared with high dogmatic Ss ($p < .01$).

Effects of acquiescence response-set on dogmatism, rigidity, and EFT were also investigated. Both the rigidity and dogmatism scales were strongly influenced by acquiescence. These effects were apparent although half the rigidity and dogmatism items had been reversed to provide equivalent numbers of "agree" and "disagree" keyed items. No significant relationship was found between EFT and acquiescence.

NARRATED PRESENTATION OF MELPAR FILM ON "THE MAZE RUNNING
VEHICLE"

L. T. Holland Jr., *Melpar, Inc.*

6. The Advanced Computer Laboratory of Melpar, Inc. has developed basic ARTRON (ARTificial neuRON) concepts that have been generalized into concepts of a Self-organizing Binary Logical Network; this will allow for a simulation of various neurological subsystem models. A basic electronic learning network consists of: sensors, primary learning network, effectors, secondary learning networks, and a fixed goal; basic electronic hardware has been built to represent this reinforcement-type learning situation.

This film of the maze running vehicle illustrates a system composed of three basic functions: (1) vehicle motion in maze paths as directed by its sensor elements, (2) turn decision commands generated by self-organizing binary logical network, (3) a decision point recognition system.

The results indicated that machines are capable of learning; machines may be constructed which learn efficiently with minimum information required for learning.

THE INDEPENDENT INFLUENCE OF RESPONSE FREQUENCY UPON IDENTIFICATION PERFORMANCE

Russell B. Johnson, *University of Virginia*

8. The role of independent response frequency in response biasing was investigated using a three-phase design. During the first task Ss learned to associate alphabet letters to 12 nonsense forms by an anticipation procedure. For a given S, the 12 form-letter pairs were learned to different criteria; either 3, 6, or 12 correct anticipations. In the second task the independent variable for four groups was the frequency manipulation of Task 1 responses in a ratio of 5 to 1 with six letters in each frequency class. Differences between the four groups consisted of the type of stimuli used in a paired-associates task (i.e., severely blurred forms or color patches) or the type of task (i.e., guessing which letter would be presented next or pronouncing aloud each letter after it had been presented). A fifth group, naming color patches, served as a control, since there was no frequency manipulation of the relevant responses. In the third task Ss were required to identify the same forms learned in Task I as well as other forms which varied in similarity to the prototypes.

The results disclosed that there was no biasing effect as is usually found. However, for those forms learned at the 3 criterion in Task 1, there was a significant tendency to use proportionately more low-frequency responses.

SERIAL LEARNING UNDER CONDITIONS OF PRIOR FAMILIAR- IZATION WITH PART OF THE LIST

Spencer R. Mathews, Jr., *University of Virginia*

1. Recent research has suggested that the classical account of serial learning is inaccurate. It is hypothesized that at least some of the items in a serial list are learned as responses to some representation of their positions.

The present experiment tests the hypothesis that serial position is the functional stimulus in the beginning of the list and adjacent items serve the greater stimulus function in the middle of the list.

Either one or three previously familiarized nonsense syllables were

inserted at the beginning (position 4 or 3, 4, and 5) or in the middle (position 8 or 7, 8, and 9) of a 16 item serial list. The standard serial learning procedure was used and 'before' errors were the data for analysis.

It was found that (1) the familiarization of items resulted in fewer errors; (2) at the beginning of the list, serial position was the only significant determiner of errors; (3) in the middle of the list the position by number of items interaction was significant (but not position by itself).

The results, though not conclusive, were taken as favoring the hypothesis that position plays the greater stimulus role at the beginning of the list and adjacent items play the greater role in the middle of the list.

DIRECTION OF TRANSFER AS A FUNCTION OF MEANINGFULNESS IN PAIRED-ASSOCIATE LEARNING

Philip M. Merikle, *University of Virginia*

2. The effects of three widely divergent levels of meaningfulness on the direction of transfer in a paired-associate learning task were studied under the A-B, B-Br (old stimuli and old responses repaired) and A-B, A-C (old stimuli and new responses) transfer paradigms. As compared with performance under the A-B, C-D (new stimuli and new responses) control paradigm, the direction of transfer for the A-B, A-Br paradigm shifted from positive to negative as the level of meaningfulness increased. Negative transfer was also found to increase consistently with increased meaningfulness for the A-B, A-C paradigm. The differential effects on the direction of transfer produced by changes in the level of meaningfulness were attributed to the relative predominance of negative effects due to associative interference under the high level of meaningfulness and to the relative predominance of positive transfer effects due to stimulus and response learning under the low level of meaningfulness.

LEFT-RIGHT REDUNDANCY AND THE PERCEPTION OF VISUAL PATTERNS

Bonnie L. Miller and E. Rae Harcum, *The College of William and Mary*

10. This study investigates the hypothesis that redundancy built into opposite halves of a binary visual pattern eliminates the usual differential in perceptual performance between right and left halves of the pattern. Five-element binary patterns of open and blackened circles were exposed tachistoscopically to the right or left of fixation successively in different exposures, or simultaneously in the same exposure. In the latter case, the two halves of the overall pattern were redundant.

With the total number of responses required of the O controlled by

instructions, the following results were obtained: (a) Fewer errors were made in reproduction of the elements to the left of fixation; (b) No significant difference was found between simultaneous and successive exposure; (c) The Os did not notice when the conditions were changed under simultaneous exposure from redundancy to non-redundancy; and (d) Fewer errors occurred when Os had to reproduce only one five-element target under all conditions, then when they had to reproduce five-element patterns on both sides of fixation in each exposure.

The conclusion from this study is that Os are not making significant use of the redundancy in the simultaneous exposure.

SOME EFFECTS OF TRAINING CHILDREN TO ADAPT COMMUNICATION TO LISTENERS WITH WIDELY DIFFERING REQUIREMENTS

Michael J. Schowalter, *The University of Virginia*

4. Previous research by Fry demonstrated that training in discriminatory tasks taught subjects to talk more to the point and cut out useless information. Generalization was not demonstrated when tested. The raining situation was here adapted to include descriptive tasks as the previously limited training might explain the failure of generalization. With 37 fifth grade students, 19 were trained in three tasks. 1) Discrimination; a speaker specified enough information about a picture of a group to allow a listener to select the specified picture from the group. 2) Description; a speaker described enough information about a picture to allow the listener to draw that picture described. 3) Discrimination and Description; a speaker attempted to communicate to a specific listener of a listening group specific information which would enable that listener to complete the task and prevent other listeners from completing the task. The results examined the pretest to posttest change. Consistent with the previous study, trained subjects on discrimination tests used significantly fewer words. Unlike the previous study, this brevity was not demonstrated by trained subjects on descriptive tasks, but they showed a significant improvement in the quality. Finally, preliminary results showed that the training failed to generalize to communicative tests differing widely from the training tasks.

INFANTILE AUTISM — A FAMILY APPROACH

Jacob Silverberg and William M. Lordi, *Memorial Guidance Clinic*

The syndrome of autism in young children characterized by profound withdrawal, lack of contact from the very first years of life, excessive

demand for sameness in the environment, lack of communication in the use of language, and preference for relationships with inanimate objects, is becoming increasingly encountered in child guidance facilities. Psychotherapy with both the child and the parents at the Memorial Guidance Clinic in Richmond, Virginia, seems to reveal that these children in the final analysis seem to represent the extension of and reaction to early narcissistic injury in the personalities of the mothers coupled with the personality of the fathers who are selected in part to be the defense against the mother's own retaliatory impulses. However, this syndrome is in need of much further research in regard to probable etiologies, as well as for the development of more effective therapeutic approaches.

PERCEPTION OF BINARY PATTERNS WITH AND WITHOUT REFERENCE MARKERS

Nelson F. Smith, *Princeton University*, and E. Rae Harcum, *The College of William and Mary*

9. When a ten-element binary pattern of open and blackened circles is exposed across the visual field, with ocular fixation at the center of the pattern, the usual result is fewest errors for the elements at the extreme left of the pattern, and most errors just to the right of the fixation point. This study was concerned with possible effects of several extraneous variables on the distribution of errors in the perception of such a binary pattern. To test the hypothesis that the mechanisms in serial learning and in tachistoscopic perception are in some respects similar, variables that would be expected to affect the distribution of errors in a learning task were manipulated in the perceptual task.

Differential placement of reference markers within the visual pattern itself, or on the response-marking sheet, did not materially affect the shape of the distribution of errors. Results were the same whether or not an attempt to control the locus of ocular fixation was attempted.

THE EFFECTS OF MULTIPLE-CHOICE FAMILIARIZATION AND SEQUENTIAL GROUPING ON PAIRED-ASSOCIATE LEARNING

Annette J. Spera, *University of Virginia*

3. A familiarization procedure was devised which required subjects to identify twelve previously seen Turkish words from groups of highly similar words using a multiple-choice-test technique. After attaining the familiarization criterion, 60 subjects were given a paired-associate (PA) learning task wherein six of the pairs were constructed from the twelve familiarized words and the remaining six were composed of unfamiliar Turkish words. It was predicted that familiarity would facilitate learning and that familiar pairs would be more easily learned than unfamiliar

pairs. For some of the subjects the familiar pairs, and likewise the unfamiliar pairs, were sequentially grouped together so as to provide a basis for organizing the list on the basis of prior familiarization; the remaining subjects were not presented with the pairs grouped in this manner. More efficient learning was expected under the grouped condition. Analysis of number of correct responses and number of before errors revealed that the familiarization procedure had a highly significant facilitatory effect on PA learning. While grouping was not significant as a main effect, there was a significant grouping by familiarization interaction which indicated that the effect of grouping was to increase the number of correct responses for familiar pairs more than for unfamiliar pairs.

EFFECTS OF HIPPOCAMPAL ABLATION ON SHOCK-AVOIDANCE BEHAVIOR

Rodney Stump, *Washington and Lee University*

16. Eighteen male, hooded rats were trained in Skinner boxes to avoid a shock by pressing the bar on the side of the box. Following this preliminary training, nine rats were dropped from the study, and the remaining nine were run for sixteen days for two hours per day. Thus a steady rate of responding was recorded.

The nine animals were then divided into three groups of three animals per group: (1) Unoperated controls, (2) Cortical controls, and (3) Hippocampals. Operations on group two removed the cortex and on group three removed the hippocampus. After ten days for recuperation, the rats were then run for ten days, and data was recorded. The results showed that the hippocampals did not press any more after the operation than before. The cortical controls pressed more and the unoperated controls also pressed more. We conclude, therefore, that the hippocampus is not involved in inhibiting responses. However, our small *N* may cause these results to be unreliable.

BAR PRESSING FOR FOOD IN THE HIPPOCAMPAL ABLATES

Rodney Stump, *Washington and Lee University*

16a. Twenty-one rats were trained to press a bar in a Skinner box to receive food. They were trained for twenty-one days to respond to a variable interval, two minute schedule which produces a steady rate of responding. The rats were then divided into three groups as in abstract number 16.

It was found that hippocampal animals pressed more than either cortical controls or unoperated controls. This may be due either to an increase in activity level or to the inhibiting of responses.

A TEST FOR ACQUIRED DRIVE BASED ON THE HUNGER DRIVE

John H. Wright, *University of Virginia*

18. The acquisition of drive properties by neutral stimuli paired with the onset of a primary aversive drive state is well established. Some investigators have attempted to impart drive properties to neutral stimuli by pairing them with different intensities of a primary appetitive drive state (e.g., hunger) but have been largely unsuccessful. However, it has been found that rats which have experienced strong hunger in a distinctive box eat more than other rats which have experienced weak hunger in the same box with primary hunger equated at the time of testing.

This experiment, instead of having two groups experience the same box under different strengths of hunger, had all Ss (42 male albino rats) experience weak hunger in one box and strong hunger in a qualitatively different box. This procedure permitted a within-S comparison of the amounts eaten in the two boxes with primary hunger equated. Results indicated that the amount eaten in the strong-drive box significantly exceeded the amount eaten in the weak-drive box, constituting evidence for conditioned hunger.

The manipulation of a second variable, delay of return to the home cage and food following strong-drive training, indicates that this difference may be attributed partly to the conditioning of an emotional reaction, produced by frustration, to the cues of the strong-drive box.

SECTION OF SCIENCE TEACHERS

The Section of Science Teachers of the Virginia Academy of Science met in the Virginia Room of the Hotel Roanoke in Roanoke, Virginia, on Thursday, May 2 at 2 P.M.

The meeting consisted of a program divided into two parts.

Mrs. J. J. Thaxton, Chairman, introduced a guest speaker, Dr. Frank Flint of Randolph Macon Woman's College, Lynchburg, Va. Dr. Flint presented a paper entitled "Challenging Virginia's Scientifically Talented Youth."

A panel titled "N.S.F. Summer Institute Summaries" was reported by Cecial W. Nelson, Emory and Henry; David Redfield, Roanoke City; and Morris Tischler, Fairfax County.

A business meeting was called to order by Mrs. Thaxton, Chairman.

Old Business: Mr. John E. Reitz, Chairman of the membership committee reported that letters of invitation had been mailed during the year to all high school teachers encouraging them to join the Academy.

New Business: A discussion was initiated by the Chairman concerning the time of the sectional meeting. A time should be found that would not interfere with the Junior Academy activities. The motion was made by Mr. John Reitz to consider a change of time. The motion was carried. A motion was made by the secretary after a discussion initiated by the chairman that no officer could hold office without being a member of the Academy. That no person be permitted to read a paper that is not a member or is sponsored by a member of the Academy. The motion was carried.

Mr. Frank Kizer, Chairman of the nominating committee made the following report: *Chairman*, Mr. John E. Reitz; *Vice-Chairman*, Mrs. Elizabeth Charlton; *Secretary*, Mr. Julius E. Williams; and *Editor*, Mr. Tom Duggins.

The slate of officers as elected as given with no nominations from the floor.

Miss Ruth Painter issued an invitation to the members to a tea at Hollins College. A motion was made by Mr. Frank Kizer that a calendar of science events be kept concerning the high schools and be made available in the notes of the Section published in the Virginia Journal. The new Chairman — Mr. John Reitz was introduced by Mrs. Thaxton. The first committee to be appointed by Mr. Reitz was the nominating committee for 1964. Mrs. Vera B. Remsburg was appointed Chairman and Mr. Thomas H. Christie Co-chairman.

The meeting was adjourned at 3:30 P.M.

Mrs. Vera B. Remsburg, *Secretary*

SECTION OF STATISTICS

Ronald Walpole, *Acting Chairman* Whitney L. Johnson, *Secretary*
Clyde Y. Kramer, *Section Editor*

MINUTES

The section business meeting was called to order at 4:10 P.M. on Friday, May 3, 1963, by acting section chairman Ronald Walpole. The previously appointed nominations committee presented their report in the form of nominations of section officers. No additional nominations were presented by those present. The nominees were as follows:

Chairman — Ronald Walpole, Roanoke College

Vice-Chairman — Frank W. Banghart, University of Virginia

Secretary — Whitney L. Johnson, Virginia Polytechnic Institute

Editor — Clyde Y. Kramer, Virginia Polytechnic Institute

Since this section of the VAS also serves as the Virginia Chapter of the American Statistical Association two additional nominations were made to serve that organization.

Whitfield Cobb to serve as chapter membership representative and on the national membership committee.

Elizabeth Angle to be nominated by the Virginia Chapter to represent district 6 on the council of ASA. This is for a two year term 1964-65.

A short discussion followed concerning increased participation in section activities and joint meetings with other statistical groups.

The business meeting was then adjourned.

In addition to the business meeting, twelve very interesting papers were presented. One paper presented was not listed on the program. This was "Probelms of Collecting and Analyzing Federal Reserve Statistics on Department Stores" by Orville K. Thompson, Board of Governors of the Federal Reserve System, Washington, D. C.

The statistics section is proud to have the honor extended to one of its members in the J. Shelton Horsley award to Herbert A. David. Congratulations "Herb."

W. L. Johnson, *Secretary*

MATHEMATICAL MODEL OF THE EFFECTS OF RADIATION ON DNA

Frank W. Banghart, *University of Virginia Medical College*

2. A mathematical model was given of the effects of radiation on the synthesis of deoxyribonucleic acid (DNA). The experimental source for the model was regenerating rat liver. Lewis strain male white rats were used. The animals were within the age range of 4-5 months and weighed approximately 200 grams. A two-third partial hepatectomy was performed under ether. Nineteen hours after hepatectomy the animals were given irradiation dosages of 188r, 375r, 750r, 1500r, 3000r, 6000r, 9000r, and 12,000r. Irradiation was given locally to the liver at the rate of 300r per minute. Adequate shielding was provided to protect the non-irradiated body areas. Immediately following irradiation fifty μ c of tritiated thymidine was injected via the animal's tail. One hour later the animal was sacrificed, the liver removed, minced and mixed. The mixed liver was pressed between slips, immersed in liquid propane then quickly transferred to ethyl alcohol and frozen at -78° C.

Staining was done by the Feulgen technique. Autoradiographs were made and grain counts were made for each hepatic cell nucleus.

The dose response curve was determined from the grain counts and a model fit to the dose response curve. The model of DNA activity is given by the second order differential equation

$$y = Ae^{-\alpha R} + Be^{-\beta R}$$

QUASI-RANK CORRELATION APPLIED TO A SELECTION PROBLEM

Frederic C. Barnett, *Virginia Polytechnic Institute*

12. It is often desired to classify an individual from a group of candidates on a continuous scale, basing the decision on a set of test scores. If the experimenter can rank a random sample of individuals according to the criterion of interest, a modified discriminant function approach is available.

Making use of the sample correlation between these ranks and a measured variate, the discriminant function is that linear combination of test scores for which this "quasi rank" correlation is maximized.

To develop distribution theory for the correlation statistic, assume a random sample of size n from a standard bivariate normal parent with parameter ρ . For $\rho = 0$, the exact density is known. Fixing the values of the ranked variate, the conditional density and moments are readily

expressed. Unconditional moments are expressible in terms of product moment of standard normal order statistics.

Available values of the latter allow exact evaluation of the first moment for all n , and of the second moment for $n = 3$.

Other moments and probabilities are to be approximated. One method produces first moments in error by less than one percent in all cases considered as long as $\rho \leq .5$.

NON-PARAMETRIC TEST FOR 2×2 AND $2 \times k$ TABLES WITH RELATED FREQUENCIES

John T. Blue, Jr., *Virginia State College*

4. In the behavioral sciences, frequency data are often used because many of the measurements are based upon nominal scaling. Moreover, cross-classification is used either to achieve some degree of homogeneity, or to develop heuristic typologies. In either case, frequency data are cast in tables, and tests of significance of differences are applied. If the researcher only cursorily examines the final tables when selecting the test of significance, he will very possibly fail to notice that the cases tabulated as frequencies are correlated. The test of significance for such data must take into account the correlation between frequencies. The purposes of this paper are to examine a set of data for correlated frequencies based on an heuristic typology, and to present suggestions for appropriately testing for significance of difference for this type of data. To accomplish these aims, we will examine an heuristic typology to show how correlation can be identified and sketch out a method for testing for significance of difference, taking account of the correlation in the data.

HIGHER MOMENTS OF A MAXIMUM LIKELIHOOD ESTIMATE, WITH AN APPLICATION TO THE NEGATIVE BINOMIAL DISTRIBUTION

Kimiko O. Bowman, *Virginia Polytechnic Institute*

10. Haldane and Smith (1956) gave the first four sampling moments of a maximum likelihood estimate $\hat{\theta}$ of θ in the case of a population classified into a finite set of classes. They gave expressions for the mean to order n^{-1} , the variance to order n^{-2} , the third cumulant to order n^{-2} , the fourth cumulant to order n^{-3} , the idea being to gain some slight additional information about the distribution of $\hat{\theta}$ when n is not large.

Earlier, Haldane had attempted the difficult problem of finding higher cumulants for simultaneous maximum likelihood estimates, but with partial success only.

Here we set out a systematic approach to the single parameter problem and also find the n^{-2} covariances for the two parameter case when the maximum likelihood estimate of one is the mean. An application to the negative binomial distribution is given.

THE METHOD OF PAIRED COMPARISONS

H. A. David, *Virginia Polytechnic Institute*

8. In the method of paired comparisons "objects" are compared two at a time, much as are teams in a Round Robin tournament. The method has interested not only statisticians but also psychologists, mathematicians, and economists. Applications include optics, consumer tests, taste testing, the study of preference behavior, and the peck-order effect.

A simple and very general approach is developed for the analyses of paired-comparison experiments. The problem of picking the best object is treated at length. Designs have been devised to cope with the situation when not all possible comparisons can be made. Probability models are discussed and a unified account of the present state of the subject is presented.

VIABILITY AND ESTIMATION OF SHELF-LIFE OF BACTERIAL POPULATIONS

Ira A. DeArmon, Jr., Michael D. Orlando, Albert J. Rosenwald, Frederick Klein, Albert L. Fernelius, Ralph E. Lincoln, and Paul R. Middaugh,
U. S. Army CBR Operations Research Group

9. Mathematical concepts associated with the exponential and probit models are developed, and the similarity of the two methods is discussed. Because of its greater flexibility in design, the probit method was used to estimate the shelf-life for four bacterial populations, wet and dry spores of *Bacillus anthracis* and wet and dry cells of *Pasteurella tularensis*. On the basis of data gained by storing these organisms at high temperature, the probit method was used to predict the time at which 50% viability would occur for cells stored at 3° C. A plane passing through a three-space showing change in percentage viability of bacteria was formulated by a multiple regression method. With this functional technique, the percentage viability, expressed as a probit, was linearly related to a logarithm of storage time and storage temperature. The use of this method to study the effect of controlled variables on the viability of cells is demonstrated by comparing the effect of viability associated with three addi-

tives used prior to drying. The results of the test gave shelf-life estimates which were too low for all additives; however, the order of stability was ranked properly as confirmed by long-term tests.

FUNCTIONAL OBSERVATIONS: A BIOSTATISTICAL STUDY OF GROWTH

Gary F. Krause, D. C. Hurst, and P. B. Siegel, *Virginia Polytechnic Institute*

11. The purpose of this research is to investigate the general concept of functional observations and relate this concept to a statistical-genetic study of AVIAN growth.

In many areas of experimental research investigators are beginning to recognize, (treat differently), a type of observation which we choose to call a "Functional Observation." A functional observation is a mathematical relationship between two or more mathematical variables *as an entity* on each individual of a sample. Thus $y_i = f_i(x)$ is a function observed for the i^{th} individual relating the mathematical variables y and x for this individual.

Considered this way, a functional observation is an element of a set of functions and a probability distribution defined over such a set would generate the statistical properties of the set.

POWER CHARACTERISTICS OF KRAMER'S METHOD FOR ANOVA OF A 2-WAY CLASSIFICATION WITH DISPROPORTIONATE SUBCLASS NUMBERS

James E. Dunn and Clyde Y. Kramer, *Virginia Polytechnic Institute*

5. A theorem by Shah and Khatri [A.M.S. (1961) 32: 883-887] is extended to give the distribution of Q/χ^2 , where Q is a definite quadratic form involving non-central normal variates and χ^2 is an independent chi-square variate. Conditions are given under which this distribution reduces to that of non-central F .

Kramer's method [Biometrics (1955) 11: 441-452] is reviewed and shown to satisfy these conditions. Non-centrality parameters are given for his method for a limited number of degrees of freedom. A mnemonic rule is given for obtaining the non-centrality parameters for higher order degrees of freedom.

Additional algebraic and empirical sampling results are given to compare the power of Kramer's method and the method of fitting constants (least squares) outlined by Yates [J.A.S.A. (1934) 24: 51-66].

A STUDY OF CHARACTERISTICS OF CERTAIN MOMENT ESTIMATORS OF
PARAMETERS FOR THE NEGATIVE BINOMIAL DISTRIBUTION

R. H. Myers, *Virginia Polytechnic Institute*

13. This paper considers characteristics (particularly bias and variance) of moment estimators of parameters for three distinct forms of the negative binomial distribution.

In previous practical work involving the negative binomial distribution, moment estimators have often been used to estimate important parameters. It has always been assumed that the efficiency of these estimators has been good (i.e., $> 90\%$) in the parameter range and sample size of interest. These conclusions were based on the calculation of the asymptotic variance of the estimators (expansion of variance to term in $1/n$). As is usually the case, the terms in $1/n$, $1/n^2$, . . . , etc. were ignored.

It is pointed out in this paper that not only do the additional terms beyond the asymptotic variance make a significant contribution toward the variance in many practical cases, but that in the very parameter range where these estimators are used practical workers have introduced an error in the variance of the estimator as great as 80-100% by using only the asymptotic expansion. It is indeed a fact that in some ranges such astronomical sample size as 20,000 or more would have to be used in order to make the additional terms negligible.

COMPARISON OF TWO DRUGS USING BAYESIAN DECISION THEORY

Armand V. Smith, *Virginia Polytechnic Institute*

1. The general problem considered in this paper is that of determining an optimum strategy for deciding how to allocate the observations in each stage of a multi-stage experimental procedure between two binomial populations (e.g., the numbers of successes for two drugs) on the basis of the results of the previous stage. After all of the stages of the experiment have been performed, one must make the terminal decision of which of the two populations has the higher probability of success. The optimum strategy is to be optimum relative to a given loss function; and a weighting function, or prior distribution, of the probabilities of success for the two populations is assumed. Two general classes of loss functions are considered, and it is assumed that the total number of observation in each stage is fixed prior to the experiment. At first it is assumed there are a fixed number of stages, but this restriction is later weakened to the restriction that only the maximum number of stages is fixed, and a stopping rule is proposed.

PROBLEMS OF COLLECTING AND ANALYZING FEDERAL RESERVE
STATISTICS ON DEPARTMENT STORES

Orville K. Thompson, *Board of Governors of the Federal Reserve System,
Washington, D. C.*

14. The Federal Reserve department store series is one of the oldest continuous statistical series compiled by the Federal Government. It was begun in the early 1920's and monthly data on total-store sales and stocks go back to 1919. Other series — including those on weekly sales and departmental sales and stocks — were first compiled in the 1940's.

Many lessons have been derived in working with this statistical program over the years, and new techniques have been developed.

At the time the Federal Reserve System embarked on the collection of department store statistics, there was little or no information available on retail trade. Department stores were chosen because of their ability to report the required figures and because their broad representation of merchandise lines very nearly reflected total retail activity.

Consideration is being given to development of a new departmental series for department stores which it is hoped will be the forerunner of a commodity or departmental-type program for all retail trade. The System feels the goal of retail trade-statistics should be in this direction, for only in this way can proper analysis be made of the flow of particular lines of goods through the retailer to the consumer.

LIST OF MEMBERS

1962 - 1963

Note: Following are the types of membership in the Academy:

****Patrons*, who contribute \$1000 or more to the Academy.

**Life Members*, who contribute \$100 or more to the Academy.

**Honorary Life Members*, who are elected by Council.

Business Members, who pay annual dues of \$100.

**Sustaining Members*, who pay annual dues of \$10.

—*Contributing Members*, who pay annual dues of \$5.

Regular Members, who pay annual dues of \$3.

Student Members, (college students only) who pay annual dues of \$1.

The number following the name designates the section, or sections, to which a member belongs.

- | | |
|--|----------------------|
| 1. Agricultural Sciences | 6. Education |
| 2. Astronomy, Mathematics
and Physics | 7. Engineering |
| 3. Bacteriology | 8. Geology |
| 4. Biology | 9. Medical Sciences |
| 5. Chemistry | 10. Psychology |
| | 11. Science Teachers |
| | 12. Statistics |

Please notify the Treasurer if any errors found in this list.

Abbott, Betty Jane, 9, 4 Drug Evaluation Branch,
Cancer Chemotherapy, Natl. Serv. Ctr., Bethesda 14, Md.
Abbott, Dr. Lynn D., Jr., 9, 5 Med. Col. of Va., Richmond
Abdalla, Mrs. Peter H., 4 101 Harris Rd., Portsmouth
Abernathy, J. K., Jr., 1 8611 Julian Rd., Richmond 29
Ackerman, C. J., 5 Dept. of Chemistry, V.P.I., Blacksburg
Adams, Prof. Clifford L. Dept. of Phys., College of Wm. & Mary
in Norfolk 2, Hampton Blvd. & Bolling Ave., Norfolk
Adams, Dr. Henry, 10 Veterans Ad. Hospital, Box 8, Richmond 19
Albemarle Paper Manufacturing Co. B Attn: Brent Halsey,
Director of Research & Development, Richmond 17

- Alden, Prof. Harold L., 2 2321 Fontaine Ave., Charlottesville
 Alderman Library Exchange Div., U. of Va., Charlottesville
 Alexander, Morris W., 1 Tidewater Research Station, Holland
 Allen, Carl W., 1 Dundas Heights, Blacksburg
 —Allen, Dr. J. Frances, 4 5702 Queens Chapel Rd., Apt. 3,
 West Hyattsville, Md.
 Allied Chemical Corporation, B Attn: F. A. Ernst, Manager,
 Nitrogen Division, Hopwell
 Alphin, R. S., 9 1600 MacTavish Ave., Richmond 30
 Alrich, Dr. E. Meredith, 9 Uni. of Va. Hospital, Charlottesville
 Alter, Dr. Bruno E. K., Jr., 2 Dept. of Physics, Randolph Macon
 Woman's College, Lynchburg
 ***American Tobacco Company, B Research Lab., Petersburg Pike,
 Richmond
 Ammerman, Don J., 2 P. O. Box 5, Dahlgren
 Amore, Dr. Thomas, 5 Cardinal Products, Inc., P. O. Box 1611,
 Durham, N. C.
 Amos, John M., 4 Price Hall, V.P.I., Blacksburg
 Anderson, A. H., 1 Forest Supervisor, USDA, George Washing-
 ton National Forest, Harrisonburg
 Anderson, Stewart W., 7, 6 108 Preston St., Lexington
 Andrako, Dr. John, 5, 9 Dept. of Chemistry, MCV Sta., Richmond 19
 Andrews, Dr. Jay D., 4 Va. Inst. of Marine Sc., Gloucester Point
 —Anslow, W. Parker, Jr., 9 Bennington Rd., Hessian Hills,
 Charlottesville
 Armstrong, Dr. Alfred R., 5 510 Newport Ave., Williamsburg
 Arrington, George E., Jr., 9 810 West Franklin St., Richmond 20
 Artz, Miss Lena, 4, 8 Waterlick
 Ashley, James D., 1 892 Merrimac Ave., Norfolk 4
 Atkins, Dr. H. Pearce, 2 1612 Bellevue Ave., Richmond 27
 Austin, John M., 11, 5 Rt. 2, Farmville
 Babashak, John F. 406 Linden Lane, Falls Church
 *Baber, Clinton W., 5, 7 Apartado 769, Caracas, Venezuela
 Bagley, Virginia S., 4 Biology Dept., Col. of Wm. & Mary, Norfolk
 Bahous, Mrs. C. Ruth, 2 410 Westwood Ave., Lynchburg
 Bailey, Dr. John Wendell, 4 27 Willway Rd., Richmond 26
 Bailey, Robert S., 4 Va. Inst. of Marine Research, Gloucester Point
 Bain, Mrs. Carl E., 11, 5 109 Maple Ave., Richmond 26
 —Baker, Dr. T. Nelson, 5 Va. State Col., Petersburg
 Baldock, Dr. Russell, 2, 5 114 Ogontz Ave., Oak Ridge, Tenn.
 **Baldwin, Dr. J. T., Jr. Col. of Wm. & Mary, Williamsburg
 Balthis, Thomas A., 5 3333 Stuart Ave., Richmond 21
 Bane, Ruby K., 5, 9 2623 Hanover Ave., Apt. 4, Richmond
 —Banghart, Dr. Frank W., 12 114 Buckingham Rd., Charlottesville

- Barbee, Edward P., 5 3916-A, Chamberlayne Ave., Apt. 2,
Richmond 27
- Barclay, Dr. Earle H., 2 Frederick College, Portsmouth
- Bargmann, Dr. Rolf E., 12 208 Carolina Rd., Yorktown Heights, N. Y.
- Barker, John G., 4 Biology Dept., Radford College, Radford
- Barnes, Robert C., 8 103 York Drive, Williamsburg
- Bartko, John J., 12 Section of Theoretical Statistics & Mathematics,
Biometric Br. NIMH, Bethesda 14, Md.
- Bass, Charles E., 8 Box 43, Stephens City
- Bass, Dr. Robert G., 5 Dept. of Chemistry, R.P.I., Richmond
- Batemen, Robert C., 5 8803 Three Chopt Rd., Apt. 206, Richmond 29
- Batten, R. Wesley, 8, 4 Box 53, Frederick College, Portsmouth
- Battig, Dr. William F., 10 Psychology Lab., Peabody Hall, U. of Va.,
Charlottesville
- Baum, Dr. Parker B., 5 930 Magnolia Ave., Norfolk 8
- Baxter, Dr. Donald L., 9 471 Briarhill Rd., Springfield,
Deleware County, Pa.
- Baylor, Crews B., 11 6503 Boatwright Dr., Richmond 26
- Beams, Dr. Jesse W., 2 Box 1882, Univ. Sta., Charlottesville
- Beitch, Irwin, C, 4 Biology Dept. Univ. of Va., Charlottesville
- Belcher, Gladys H., 4 White Marsh
- Belcher, James E., Jr., 5 305 Myrtle St., Ashland
- *Bell, C. Cooper, Jr., 9 710 Keats Rd., Richmond 29
- Bell, Robert H., 5 Elberon, Surry County
- Bell, Dr. Wilson B., 9 V.P.I., Blacksburg
- Bennett, Melvin B., 5 210 Defense Ave., Sandston
- Benoit, Dr. E. Paul, 10 Jewish Foundation for Retarded Children,
6200 Second St., N.W., Washington, D. C.
- Benson, Don G., Jr., C, 4 Dept. of Biology, U. of Va, Charlottesville
- Benson, Mrs Katherine A., C, 4 Dept. of Biology, U. of Va., Charlottesville
- Benton, Prof. Arthur F., 5 Cobb Chemical Lab., U. Sta., Charlottesville
- Benton, James E., 11, 5 1000 North Lombardy St., Richmond 20
- Berne-Allen, Dr. Allan, 5, 7 144 N. Washington Dr., St. Armands Key,
Sarasota, Fla.
- Berry, Dr. Paul C., 10 507 18th Street, South, Arlington 2
- Berry, Rodney C., Jr., 5 6312 Bliley Rd., Richmond 25
- Berry, Rodney C., Sr., 5 5907 Brokfield Rd., Richmond 27
- Bevan, Dr. Arthur, 8 Churchville
- Bice, Prof. Raymond C., Jr., 10 Peabody Hall, U. of Va.,
Charlottesville
- Billmyer, F. W., Jr., 5 Old Dominion College, Norfolk 8
- Bird, George C., 5 Phipps & Bird, Box 2-V, Richmond
- Bird, Lloyd C., 3 303 South 6th St., Richmond

Bird, Dr. Samuel O., 8 Box 2241, Mary Wash. Col., Fredericksburg
 —Black, Dr. Zoe, 4 1202 Prince Edward St., Apt. 5, Fredericksburg
 Blackmore, Dr. Raymond H., 5 Philip-Morris Research Center,
 Richmond 6
 Blackwell, Jane, 11, 5 Box 514, South Boston
 Blair, Miss Barbara, 5 Sweet Briar Col., Sweet Briar
 Blake, Dr. Archie, 12 6620 S. Foresthill St., Littleton, Colorado
 —Blake, Dr. John A., 10 4003 Patterson Ave., Richmond 21
 *Blank, Grace J., 9 P. O. Box 216, Williamsburg
 Blaser, Dr. R. E., 1, 4, 12 V.P.I., Blacksburg
 Blickenstaff, Mrs. I. C., 5 Doswell
 Blincoe, Dr. J. W., 2 Ashland
 —Bliss, Dr. Laura, 5 322 Sumpter Street, Lynchburg
 —Blomquist, Dr. John H., 7, 5 1210 Chatham Rd., Waynesboro
 Bobb, Dr. Marvin L., 4 Piedmont Fruit Research Lab., Charlottesville
 Bodenstein, Prof. Dietrich, 4 Dept. of Biology, U. of Va., Charlottesville
 —Boggess, Charles S., 5 4407 Forest Hill Ave., Richmond 25
 *Boggs, Prof. Isabel, 2 14 Parkmont Apts., Lynchburg
 Boggs, Miss Sybil, 11, 2 3110 Webster Ave., Kemp Lane, Norfolk 19
 Boldridge, Frank, 5 305 Henry St., Ashland
 Bond, Queta C., 4 The Cottage, Oakmont, North Garden
 Bond, Dr. W. R., 9 1722 Westwood Ave., Richmond 27
 Booth, Fitz, 5, 7 2607 Park Ave., Apt. 1, Richmond 20
 —Boozer, Miss Mary E., 12 1140 West Grace St., Richmond 20
 Borchers, Dr. Edward A., 1 Box 2160, Norfolk 1
 Borzelleca, Joseph F., 9 Dept. of Pharmacology, MCV Sta., Richmond 19
 **Bosher, Dr. Lewis H., Jr., 9 MCV Sta., Richmond 19
 Bouton, Dr. S. Miles, Jr., 9 Rt. 1, Cherry Hill Farm, Evington
 Bowden, Charles M., 2 8319 Mark Lawn Dr., Richmond 29
 Bowen, Dr. Leroy E., 1 505 Elmwood Ave., Lynchburg
 Bowles, John L., 8 4801 Connecticut Ave., Washington, D. C.
 —Bowman, Edward R., 6, 9 Dept. of Pharmacology, MCV Sta.,
 Richmond 19
 —Bowman, Dr. Paul W., 4 3114 5th St., North, Arlington
 Bowman, Dr. Raymond P. G., 6 609 Progress St., Blacksburg
 —Boyer, Dr. William, Vice Pres., 5 Va.-Carolina Chemical Corp.,
 4th and Main Sts., Richmond 19
 Bradfield, W. E., 10, 6 198 Hemlock Dr., Blacksburg
 Bradley, Frank D., 3 4249 25th St., North, Arlington 7
 —Brand, Dr. Eugene D., 9 Dept. of Pharmacology, Univ.
 Hospital, Charlottesville
 Brewer, C. Fred, 2 Col. of Wm. & Mary in Norfolk, Hampton Blvd.
 & Bolling Ave., Norfolk

Brice, Dr. Luther K., Jr., 5 Chemistry Dept., V.P.I., Blacksburg
Bridges, Troy D., 11, 5 2012 Adams Lane, Falls Church
Bristol, Mrs. Roger P., 8 1808 Barracks Rd., Charlottesville
—Brittingham, Dr. William H., 1 Box 2160, Norfolk 1
*Brigden, C. E., 5 11 Greenway Lane, Richmond 26
Brooks, Clyde J., 5 P. O. Box 1103, Lynchburg
Brooks, Dr. Coy C., 4 Animal Husbandry Dept., V.P.I., Blacksburg
Brooks, G. R., 4 Dept. of Biology, Col. of Wm. & Mary, Williamsburg
Brown, Earle S, Jr., 5 4004 Wilmont Dr., Richmond 22
—Brown, Dr. Frederick L., 2 308 Montebello Circle, Charlottesville
Brown, George Gordon, 4 824 West 44th St., Richmond 25
Brown, Harold A., 11, 4 Box 268, South Boston
Brown, Irby H., 5 1300 E. Franklin St., Richmond 19
Brown, Dr. Jack Stanley, 4 Dept. of Biology, Emory & Henry Col.,
Emory
Brown, Dr. Paul L., 4 Norfolk Div., Va. State Col., Norfolk
Brown, Dr. W. Horati, 8 Box 114, Wytheville
Brown, Lt. Col. Warren W., 5, 6, 11 Box 73, Kable Sta., Staunton
Brubaker, Dr. Kenton K. RFD 1, Manheim, Penn.
Bruce, Dr. Robert B., 5 3612 Seminary Ave., Richmond 27
*Brumfield, Dr. Robert T., 4 Longwood College, Farmville
—Bruner, B. M., 5 105 North Wilton Rd., Richmond 21
Bruner, Earl H., 1, 8 Box 238, Charlottesville
Brunsvoild, Col. K. T., 11 3109 Russell Rd., Alexandria
Bryant, R. E., Jr., 5 2623 Linbrook Dr., Richmond
Bull, Fred W., 7, 5 V.P.I., Blacksburg
Bully, Miss Kathryn, 4 169 LaSalle Ave., Hampton
Bumpass, Jimmy, c, 4 Rt. 3, Bumpass
—Burke, Dr. Jack D., 4 Biology Dept., Uni. of Richmond
*Burns, Prof. G. Preston, 2 P. O. Box 1005, Col. Sta., Fredericksburg
Burton, Willard W., 5 6556 Hagueman Dr., Richmond 25
Butler, James T., 5 1204 Bobbiedell Lane, Richmond 29
Buttermark, Robert J., 11 307 North Washington St., Alexandria
Buxton, Dr. W. D., 9 Univ. of Va. Hospital, Charlottesville
Byrd, Dr. J. Rogers, 4 Dept. of Biology, Col. of Wm. & Mary,
Williamsburg
Byrd, Dr. Mitchell A., 4 Dept. of Biology Col. of Wm. and Mary,
Williamsburg
Byrn, Mrs. Jane N., 4, 5 Christopher Newport Col., Newport News
Byrne, Col. William E., 2 Box 836, Lexington
Cabrera, Dr. N., 2, 5 Dept. of Physics, Un. of Va., McCormick Rd.,
Charlottesville
Callahan, William H., 8 1 Rowe Place, Franklin, N. J.

- Calver, James L., 8 Box 3667, Univ. Sta., Charlottesville
- *Caminita, Mrs. B. H., 3 827 Marye St., Fredericksburg
- Campbell, Dr. Addison D., 2, 9 8520 Julian Rd., Richmond 29
- Canham, Richard G., 5 Asso. Prof., Col. of Charleston,
Charleston, S. C.
- *Carman, George Gay, 2 3907 W. Franklin St., Richmond 21
- Carnes, Mrs. Mary B., 9, 4, 5 3 Columbia Court, Apt. 1, Cincinnati, O.
- Carpenter, D. R., Sr., 2 620 High St., Salem
- Carpenter D. Rae, Jr., 2 Physics Dept., V.M.I., Lexington
- Carr, Francis F., 1 400 North Eighth St., Box 10026, Richmond 40
- Carroll, Dorothy, 8 U. S. Geological Survey, Washington 25, D. C.
- Carroll, Robert P., 4 Box 613, Lexington
- Carter, Miss Linda L., 10 Children's Service Center Univ. Hosp.,
Charlottesville
- Carter, R. C., 4 Animal Husbandry Dept., V.P.I., Blacksburg
- Carver, Dr. Merton E., 10 Univ. of Richmond, Richmond
- Carver, T. Granville, 5 1004 W. 49th St., Richmond 25
- Cary, Miss M. Katherine, 9, 5 Box 817, MCV Sta., Richmond
- Castor, W. S., Jr., 5 2212 Taylor Farm Rd., Lynchburg
- Chace, F. M., 8 The M. A. Hanna Co., 1300 Leader Bldg.,
Cleveland, Ohio
- Chamberlain, Dr. J. L., 4 Biology Dept., Randolph-Macon
Woman's College, Lynchburg
- Chapman, Dr. Douglas C., 9 324 Clovelly Rd., Richmond
- Chappell, Dr. Wilbert, 5 Madison College, Harrisonburg
- Chesson, R. R., 5 6 Lexington Rd., Richmond 26
- Chevalier, Dr. Paul L., 9 11 East Franklin St., Richmond 19
- Chew, Victor, 12 RCA Service Co., Bldg. 423, Mail Unit 114,
Patrick AFB, Fla.
- Chi Beta Phi, Iota Sigma Chapter Radford College, Radford
- Choate, M. S., Jr., 10 Pamela Dr., Richmond 29
- Christie, Thomas H., 11 3713 W. Washington Blvd., Arlington
- Chumney, Richard D., 1 Box 1163, Richmond 9
- Churchill, Miss Helen, 4, 3, 9 Hollins College, Hollins
- Claffey, Dr. Lawrence M., 5 208 Orchard View Lane, Blacksburg
- Clague, Prof. W. Donald, 5, 9 Bridgewater
- Claiborne, Miss Imogene B., 5 2413 Terrell Place., Lynchburg
- Clark, Allen K., 5 Dept. of Chemistry, Norfolk Col. of Wm. & Mary,
Norfolk
- Clay, John W., 1 RFD 2, Box 384, Ellerson
- Clayton, Dr. C. C., 5 MCV Station, Richmond 19
- Clough, Dr. O. W., 9 Medical College of Va., Richmond
- Coalter, Mrs. Gwendolyn, 11, 4 3456 McGuire Dr., Richmond 24

- Cobb, Dr. Whitfield, 12 845 Peyton St., Roanoke
- Cocke, E. C., 4 College Station, Winston-Salem, N. C.
- Cockerille, Dr. F. O., 5 Greenwood
- Cofer, Mrs. Gilbert S., 11, 5 4703 Taney Ave., Alexandria
- Cogbill, Dr. E. C., 5 American Tobacco Co., Research Lab., Peters-
burg Pike, Richmond
- Cole, Dr. James W., 5 Cobb Chemical Lab., U. of Va., Charlottesville
- Coleman, Arthur P., Jr., 11, 4, 9 1053 N. Chamblis, Alexandria
- Coleman, C. S., 1, 8 P. O. Box 194, Fairfax
- *Coleman, G. Gravatt, 7 Box 521, Rt. 2, Lancaster
- Coleman, George W., Jr., 4, 5, 2 ... 621 Staunton Ave., N.W., Roanoke
- Coleman John S., 2, 6 3010 N. Florida St., Arlington 7
- *College of William and Mary Williamsburg
- Colmano, Dr. Germille, 9 Dept. of Vet. Sc., V.P.I., Blacksburg
- Compton, Dr. Jack, 4, 5 Inst. of Textile Technology, Charlottesville
- Cook, Mrs. F. Hartwick, 2, 5, 12 Alton State Hospital, Alton, Ill.
- Cool, Dr. R. D., 5 Madison College, Harrisonburg
- Cooper, Dr. Byron N., 8, 7 Box 634, Blacksburg
- Cooper, Miss Frances, 5, 4 1301 Third Street, S. W., Roanoke
- Cooper, Dr. Pascal W., 5 301 Ohio Ave., Harrisonburg
- Copeland, Graham, 1 1112 State Office Bldg., Richmond
- Corbett, James E., Jr., 2 926 Hamilton St., Richmond 21
- Cornfield, Jerome, 12 Box 524, Route 1, Great Falls
- *Coty, O. N., 5 515 Ridge Top Rd., Richmond 26
- Couper, Dr. Monroe, 5 1925 Cherokee Rd., Waynesboro
- Covell, Charles V., Jr., 4 Dept. Entomology, V.P.I., Blacksburg
- *Cox, Edwin, 5 Holly Hill, Aylett
- Cox, Edwin, III, 5, 7 Holly Hill, Aylett
- Cox, Edwin L., 12, 4 Biometrical Services, ARS, Plant Ind. Div.,
Beltsville, Md.
- Cox, Mary Lee, 11, 5, 4 3654 Radford St., Norfolk 13
- Cox, Norman R., 5 5209 Forest Hill Ave., Richmond
- Craighead, R. A. Gen. Office Bldg., N. & W. Rwy., Roanoke
- Crandall, Dorothy L., 4 Box 278, R.M.W. Col., Lynchburg
- Crawford, Dr. George W., A 205 John Wythe Pl., Williamsburg
- Crawford, Stuart C., 5, 4, 7 Box 124, Franklin
- Crayton, Frank H., 4 6343 Glyndon Lane, Richmond 25
- Cribbs, Dr. Richard M., 4, 9 Dept. of Biology & Genetics, MCV
Station, Richmond 19
- Crim, David M., 2, 11, 7 402 Roanoke St., Blacksburg
- Crimm, Samuella H., 4, 11 Glassboro State Teacher's Col.,
Glassboro, N. J.
- *Crittenden, Dr. Eugene D., 5 Hopewell

- Crouch, Joseph P., 9 1019 Oakley Ave., Lynchburg
- Crowell, Prof. Thomas I., 5 Cobb Chemical Lab., Charlottesville
- Crownfield, Frederic R., 2 312 Cary St., Williamsburg
- Cruser, Melvin E., Jr., 2 5305 Lakeside Dr., Virginia Beach
- Cummins, Dr. Milton D., 9 1001 West Franklin St., Richmond 20
- Cutler, M. Rupert, 4 1500 Massachusetts Ave., Apts., Apt. 528,
Washington 5, D. C.
- Daffin, Prof. John B., 5, 2 Mary Baldwin College, Staunton
- Dan River Mills, Inc., B Attn: L. Aubrey Goodson, Jr., Vice Pres. &
Director of Research, Danville
- Dancy, William H., Jr., 2 Route 4, Box 141, Charlottesville
- Daniel, Thomas Richard C, 4 Lake Waramaug, New Preston, Conn.
- *Darden, Prof. Colgate W., Jr. 1013-14 Bank of Commerce Bldg.,
Norfolk
- Daughtrey, Mrs. William H., 4 3906 Cary St. Rd., Richmond 21
- **Davenport & Company 1113 E. Main St., Richmond
- David, Dr. H. A., 12 Dept. of Statistics, V.P.I., Blacksburg
- Davies, Dr. E. F. S., 6 Va State Col, Petersburg
- Davies, William E, 8 125 W. Greenway Blvd., Falls Church
- Davis, Donald, 4 1163 Tyler Ave., Newport News
- Davis, Loyal H., 5, 2 Box 1895, Richmond 15
- Davis, Thursa F., 5 Va. State Col., Petersburg
- DeArmon, Ira H., Jr., 12 219 Broadway, Bel Air, Md.
- Deck, Dr. J. David, 9 Dept. of Anatomy, U. of Va. Hospital,
Charlottesville
- Decker, Miss Mary G., 5 1014 Long St., Charlottesville
- DelPriore, Francis R., 12 9517 Hammett Parkway, Norfolk 3
- Delzell, Dr. David E. Dept. Biology, Norfolk Col. of Wm. & Mary,
Norfolk
- Eugene D. Denman, 2 2611 Jefferson Park Circle, Charlottesville
- Denny, Dr. George H., Jr., 5 Dept. of Chemistry, V.P.I., Blacksburg
- Dent, Francis C. 2112 Spencer Rd., Richmond 30
- Dent, Dr. J. N., 4 Dept. of Biology, U. of Va., Charlottesville
- Derby, James R., 8 205 Washington St., Blacksburg
- Derting, John F., 8, 1 P. O. Box 403, Georgetown, British Guiana
- Devers, Mrs. Evelyn G., 11, 4 647 Sleepy Hollow Rd., Falls Church
- Dewey, Dr. Lovell J., 5 Box 726, MCV Sta., Richmond 19
- Diana, Dr. Leonard M., 2 4111 Hillcrest Rd., Richmond 25
- Diana, Dr. Pearl B., 10 4111 Hillcrest Rd., Richmond 25
- Dietrick, L. B., 1 506 Preston Ave., Blacksburg
- Dinwiddie, Dr. J. G., 5 620 Walnut Ave., Waynesboro
- Dodd, Dr. Eileen K., 10 Box 1205, College St., Fredericksburg
- Dofflemoyer, Jean, C, 4 612 Rugby Rd., Charlottesville

- Domermuth, Prof. C. H., 3, 4 Dept. of Vet. Sci., V.P.I., Blacksburg
- Dow Chemical Company, B Attn: O. R. McIntire, Technical Dir.,
Textile Fiber Dept., James River Div., Williamsburg
- Drumheller, Warren D., C, 2 Box A-350, Va. Tech Sta. A, Blacksburg
- DuBose, Dr. R. T., 9 Dept. of Vet. Sci., V.P.I., Blacksburg
- Duke, Miss Martha W., 4, 1 1 721 Park St., Charlottesville
- *Duncan, Dr Cecil E., 2 865 Thornwood Dr., Palo Alto, Calif.
- Duncan, Mrs. Geraldine, 9 8885 Marchant Ave., Atascadero, Calif.
- Dunlap, Miss Elizabeth, 11 Spring Farm, Lexington
- Dunn, Jim, C, 12 Box 3502-A, V.P.I., Blacksburg
- Dunn, Dr. Richard H., 4 Va. State Col., Petersburg
- Dunton, Dr. E. M., Jr., 1 Va. Truck Expt. Sta., Painter
- ***DuPont, Mrs Alfred I. Nemours, Wilmington, Del.
- E. I. duPont de Nemours & Co., B Attn: J. W. Morrison, Jr.,
Personnel Superintendent, P. O. Box 1477, Richmond
- Eades, Dr. James B., 7 Box 351, V.P.I., Blacksburg
- Eanes, Mrs. Dolores D. Box 453, Fieldale
- Earp, Prof. U. F., 7 1103 Palmer Dr., Blacksburg
- Ebinger, Dr. John E., 4 Dept. of Biology, Roanoke Col., Salem
- Eckel, Dr. John F., 7 110 Highland Ave., Blacksburg
- Ellison, Robert Lee, 8 2131 Tarleton Dr., Charlottesville
- Emory, Samuel T., 8 608 Hawke St., Fredericksburg
- Edmundson, Dr. R. S., 8 1707 Kenwood Lane, Meadowbrook
Heights, Charlottesville
- Edwards, Dr. Leslie E., 9 Psysiology Dept., MCV Sta., Richmond 19
- Eisenhart, Dr. Churchill, 12 National Bureau of Standards,
Washington 25, D. C.
- Elarth, Herschel A., 7 106 York Dr., Blacksburg
- Elder, John H., 5, 1 3800 Plymouth Dr., Richmond 22
- Elder, John H., Jr., 1, 4 Box 145, Madison
- Ellett, Virginia C., 11 Thomas Jefferson H. S., Richmond 21
- *Emmett, Dr. J. M., 9 C & O Hospital, Clifton Forge
- Emmons, Lyman Randlett, 4 Dept. of Biology, W. & L. U., Lexington
- Engel, Dr. R. W., 5 V.P.I., Blacksburg
- English, Prof. Bruce V., 2 109 Arlington, Ashland
- Enrick, Norbert Lloyd, 12 Graduate School of Business, U. of Va.,
Charlottesville
- Edmonds, Marvin D., 5 1315 Foster Rd., Richmond 25
- Ern, Prof. Ernest H., 8 Dept. Geology, U. of Va., Charlottesville
- Essary, Prof. E. O., 1 Poultry Dept., V.PI., Blacksburg
- Evert, Dr. Henry, 5, 4 11 Harvard St., Garden City, N. Y.
- *Faulconer, Dr. Robert Jamieson, 9 Dept. of Pathology, DePaul
Hospital, Norfolk 5

- Feagans, Eugenia C, 8, 2 323 South Church St., Woodstock
- Feinstein, H. I., 5 George Mason College, Bailey's Crossroads
- Ferneyhough, Dr. Robert E., 9 Box 380, Warrenton
- Ferry, James F., 4 231 Campbell St., Harrisonburg
- Fields, Dr. Victor H., 5 Box 32, Hampton Institute, Hampton
- Filer, Dr. Robert J., 10 Univ. of Richmond, Richmond
- Fillinger, Harriett H., 5, 2 Box 612, Hollins College
- Finch, Marian P., 11, 4 9 Malvern Ave., Apt. 6, Richmond
- Finger, Prof. Frank W., 10 Peabody Hall, University
- First and Merchants National Bank, B Attn: Mr. R. T. Marsh,
President, Richmond 17
- Fischer, Dr. Ernst, 9, 4 Medical Col. of Va., Richmond
- Fisher, Elwood, 4 381 Monticello Ave., Harrisonburg
- Fisher, Dr. Robert A., 7, 5 106 Cohee Rd., Blacksburg
- Fitzpatrick, J. F., Jr., 4 Dept. of Biology, U. of Va., Charlottesville
- Fitzroy, Herbert W. K., 6 1 West Main St., Richmond Area,
University Center, Richmond
- Flagg, Dr. Raymond O., 4 Carolina Biological Supply Co.,
Burlington, N. C.
- Flint, Dr. Franklin F., 4 Box 309, R.M.W.C, Lynchburg
- Flory, Dr. Walter S., Jr., 4, 1 Blandy Exper. Farm, Boyce
- Flowers, Wm. L., 5 8719 Weldon Dr., Richmond
- Floyd, Miss Susie V., 4 Hopkins St., Newport News
- Fontenot, Dr. J. P., 5 Dept. of Ani. Husb., V.P.I., Blacksburg
- Forbes, Dr. Allan L., 9 ICNND Bldg., 16, NIH, Bethesda 14, Md.
- *Forbes, Dr. J. C., 5, 9, 2 MCV Richmond 19
- Forslev, Dr. Albert W. 8 The Norfolk Col. of Wm. & M, Norfolk 8
- Franko, Dr. Bernard V., 9 A. H. Robins Bio Res. Labs.,
Sherwood & Reserve Ave., Richmond 20
- Frederick, Laurence W., 2 L. McCormick Observatory, U. of Va.,
Charlottesville
- Freer, Prof. Ruskin, 4, 8 Lynchburg College, Lynchburg
- Freitag, Mrs. Herta Taussig, 2 Hollins College, Hollins
- French, R. H., 5 Longwood College, Farmville
- Freund, Dr. Jack, 9, 5 622 N. Boulevard, Richmond
- Friedericy, Dr. J. A., 7 Thornton Hall, U. of Va., Charlottesville
- Friedman, Samuel J., 2, 5 30 Ridgewood Circle, Wilmington, Del.
- *Froehling & Robertson, Inc. Attn: J. M. Weaver, Chief Chemist,
P. O. Box 737, Richmond 6
- Fuqua, Mrs. F. C., 9 3005 Linden Ave., Fredericksburg
- Furr, A. Keith, 2 Route 1, Box 275-A, Blacksburg
- Furr, Hal, 11 care Suffolk High School, P. O. Box 1594, Suffolk
- Furtsch, Dr. E. F., 5, 6 P. O. Box 618, Blacksburg
- Fussell, Mrs. Bernice N., 11, 4 Clover

- Gager, Forrest L., Jr., 5 7313 Lee Circle, Richmond 25
- Gamble, Samuel J. R., 5 Lynchburg College, Lynchburg
- Gant, Dr. James Q., Jr., 9 1801 Eye Street, N. W., Suite 812,
Washington 6, D. C.
- Garber, Louis L., 10 Box 1080, Staunton
- Gardner, Laurence H., II, 8 4 Canderbury Rd., Bellair, Charlottesville
- Garner, W. N. Roanoke College, Salem
- Garretson, Harold H., 5 Lynchburg College, Lynchburg
- Garrett, Dr. H. E., 10 1872 Winston Rd., Charlottesville
- Garrett, Mrs. Joanne H., 5 421 Westover Hills Blvd., Apt. 204,
Richmond 25
- Garrett, Dr. Richard E., 2 Box 615, Hollins College
- Geldard, Dr. Frank A., 10 319 Nassau St., Princeton, N. J.
- Gemmill, Chalmers L., 9 Dept. of Pharmacology, U. of Va.,
Charlottesville
- General Electric Company, B Attn: Paul R. Thompson,
150 Roanoke Blvd., Salem
- German, Dr. Leslie, 5 410 V.M.I. Parade, Lexington
- Gevers, Alan I., 4 471 Sage Hall, Cornell Univ., Ithaca, N. Y.
- Gibson, Prof. Theodore W., 2 Wise
- Gilbert, Ray C., 8 Box 758, Elkader, Ia.
- Gildersleeve, Benjamin, 8 1808 Kirby St., Bowling Green, Ky.
- Gillespie, Dr. J. Samuel, Jr., 5, 7 22 Maxwell Rd., Richmond 26
- Gillespie, Robert F., Jr., 4 Christ Church School, Saluda
- Gilliam, Jane E., 11, 2 566 Blount Pt. Rd., Newport News
- Gilmer, Dr. Thomas E., 2 President, Hampden-Sidney College,
Hampden-Sidney
- Gilmer, Dr. T. E., Jr., 2 909 Preston Ave., Blacksburg
- Gilpin, Robert H., 4 Bedford Rd., Cumberland, Md.
- Gilreath, Dr. E. S., 5 Box 745, Lexington
- Gist, Lewis A., Jr., 5 Norfolk Div. of Va. State Col., Norfolk 4
- Gladding, R. N., 5 American Tob. Research Lab., 400 Petersburg
Pike, Richmond
- Gladding, Mrs. Walter, 5, 9 1613 Park Ave., Richmond 20
- *Glass, Jewel J., 8 U. S. Geological Survey, Washington, D. C.
- Glick, Rudolph A., 2 Bridgewater College, Bridgewater
- Glock, Dr. Eugene, 5 American Tob. Co., Res. Lab., Richmond
- **Goethe, C. M. 3731 T. Street, Sacramento 16, Calif.
- Goldstein, Lewis C., 4 5207 Monument Ave., Richmond 26
- Gordon, Elmer L., 5 404 North 12th St., Richmond
- Gordon, John R., 2 Box 634, Union Station, Baton Rouge, La.
- Gould, Henry W., 2 West Va. Univ., Dept. of Mathematics,
Morgantown, W. Va.
- Gourley, Dr. D. R. H., 9 Univ of Va. Medical School, Charlottesville

- Handley, Charles Overton, Jr., 4 U. S. National Museum,
Washington 25, D. C.
- Handy, E. S. C., 4, 10 Box 57, Oakton
- *Hanmer, H. Rupert, 5 400 Petersburg Turnpike, Richmond 24
- Hansen, Prof. P. Arne, 3, 4 Dept. Microbiology, U. of Md.,
College, Park, Md.
- Harcum, Dr. E. Rae, 10 482 Penniman Rd., Williamsburg
- Hardcastle, James E., 5 4824 Arundel Ave., Richmond
- Hargis, Dr. William J., Jr., 4 Va. Inst. of Marine Sci.,
Gloucester Point
- Harker, Joseph N., Jr., 2, 11 2302 Wycliffe Ave., S. W., Roanoke
- *Harlan, Dr. William R., 5 329 Greenway Lane, Richmond 26
- *Harlow, Edward S., 5 2604 Monument Ave., Apt. A, Richmond 20
- Harnsberger, W. T., Jr., 8 Madison College, Harrisonburg
- Harowitz, Charles L., 5 7804 Meherrin Rd., Richmond
- Harper, Laura Jane, 4 P. O. Box 495, Blacksburg
- Harrell, Dr. Bryant, 5 AID, Nebraska Gp., APO 254, care Post-
master, New York City
- Harrell, Cleon, 12 Princess Anne
- Harrell, Ruth Flinn, 10 6411 Powhatan Ave., Norfolk 8
- Harrington, Mrs. Beatrice A., 2 2024 Barton Ave., Richmond 22
- Harris, Dr. Orville R., 7, 2 2017 Spottswood Rd., Charlottesville
- Harris, Dr. William E., 10 2407 Pulliam Rd., Bon Air
- Harrison, Edward R., Jr., 4, 1414 Varnum St., N.W., Washington 11, D.C.
- Harrison, Dr. Wyman, 8 Va. Inst. of Marine Sci, Gloucester Point
- Harrow, Lee S., 5 Box 500, A.S.R. Prod. Co., Staunton
- Harshbarger, Dr. Boyd, 12 Dept. of Statistics, V.P.I., Blacksburg
- Hart, C W., Jr., 4 Acad. of Nat. Sci. of Phila., 19th and Parkway,
Philadelphia 3
- Hathaway, Mrs Beverley S., 11, 4 P.O. Box 6, Horseshoe Hill,
Keswick
- Havron, Dr. M. Dean, 10 6713 Relee Rd., Falls Church
- Heatwole, Mrs. Thelma C., 2 P. O. Box 7082, Richmond
- Hefferman, James D., 2 740 Granby St., Norfolk
- Heflin, Col. S. M., 2 508 Highland Rd., Lexington
- Hegre, Dr. Erling S., 9 MCV Station, Richmond 19
- Heisey, Dr. Lowell, 5, 3 Bridgewater College, Bridgewater
- Hembree, Dr. Howard W., 10 2720 Forest Hills Rd., Petersburg
- Hench, Miles E., 3 4802 Kensington Ave., Richmond 26
- Henderson, R. G., 1, 4 Plant Path. & Phys. Dept., V.P.I., Blacksburg
- Henneman, Dr. Richard H., 10 Psych. Lab., University
- Hereford, Dr. F. L., 2 Dept. of Phys., U. of Va., Charlottesville
- Hering, Mrs. T. T., 4, 2, 11 Rt. 2, Staunton
- Hester, Mrs John E., 4, 7 916 Onslow Dr., Greensboro, N. C.

- Hess, Margaret, 4, 11 2933 Kingland Rd., Richmond 34
- Heterick, Robert C., Jr., 7 210-C Dehart St., Blacksburg
- Hickman, Don W., 4 Lot 29, Blacksburg Turnpike, Blacksburg
- Higgins, Dr. Edwin S., 9, 5 Dept. of Biochem., MCV Sta., Richmond 19
- Hildreth, Dr. H. M., 10 7607 Lakeview Dr., Falls Church
- Hill, C. H., 4 320 Miller St., Winchester
- Hillsman, Overton L., 5814 Crestwood Ave., Richmond 26
- Hinton, Dr. William, 10 15 Jordan St., Lexington
- Hoak, James F., 2 Luray
- Hobbs, Herman H., 2 301 S. Jefferson St., Arlington 4
- Hobbs, Dr. Horton H., Jr., 4 Room 301, U. S. Natl. Museum,
Washington 25, D. C.
- Hoch, Hans, 5, 2 Geriatrice, VA Center, Martinsburg, W. Va.
- Hoch-Ligeti, Dr. Cornelia, 9 128 Main St., Sheperdstown, W. Va.
- Hoff, E. C., 9, 4, 10 MCV Sta., Richmond 19
- Holcomb, Carl J., 4 Ext. Forester V.P.I. Blacksburg
- Holland, Charles T., 7 109 McLean Ave., Morgantown, W. Va.
- Holliman, Dr. Rhodes B., 4 Dept. of Biology, V.P.I., Blacksburg
- *Hollins College Hollins College
- Holloway, Harry Lee, Jr., 4 Roanoke College, Salem
- Holmes, Dr. B. T., 9 300 E. Third St., Frankfort, Ky.
- Holmes, Dr. C. E., 1 Dept. of Poultry Sci., V.P.I., Blacksburg
- Holmes, J. C., 5 215 Campbell St., Harrisonburg
- Holmes, Wilbur H., 11, 5 829 Twentieth St., Newport News
- Holt, Bernard S., Jr., 5 3631 Wakefield Rd., Richmond 25
- Holt, Charles A., 7 1311 Oak Dr., Blacksburg
- Holt, Dr. Perry C., 4 Biology Dept., V.P.I., Blacksburg
- Honkala, Adolf U., 8 3819 Arklow Rd., Richmond 35
- Horn, Robert H., 11, 5 Locust St., Marion
- Horne, Dr. T. J., 1, 6 1013 Draper Rd., Blacksburg
- Hornyak, Dr. Frederick M., 5 Chem. Dept., V.P.I., Blacksburg
- *Horowitz, Alan S., 8 Box 269, Littleton, Colo.
- *Horsley, Dr. Guy W., 9 617 W. Grace St., Richmond
- Horton, Mrs. Loetta W., 11, 2 4431 Hazel Ridge Rd., Roanoke
- Hosner, John F., 4 Dept. of Forestry & Wildlife, V.P.I., Blacksburg
- Hostetter, Dr. D. Ralph, 4, 8 Eastern Mennonite Col., Harrisonburg
- Hough, Dr. W. S., 4, 1, 8 523 Fairmont Ave., Winchester
- Howe, A. Gregory, 5 429 Beauregard Ave., Petersburg
- Howes, C. E., 1 Head Dept. of Poultry Sci., V.P.I., Blacksburg
- *Hoxton, L. G., 2 U. of Va., McCormick Rd, Dept of Physics,
Charlottesville
- Hubbard, Robert M, 7, 5 311 Montebello Circle, Charlottesville
- Hudgins, Webster R., 5 Port Haywood

Adams, Mrs. Bernice C., 11 3576 Norland Court, Norfolk 19
 —Hudson, M. W., 5, 1 Box 3498, Richmond
 —Huf, Dr. Ernst G., 9 MCV Sta., Richmond 19
 Hufstedler, Dr. Robert S., 5, 12 .. Old Dominion Col., Box 6173, Norfolk 8
 Hughes, Hansel L., 5 1538 W. 50th St., Norfolk
 Hughes, Dr. Roscoe D., 4, 9 Medical Col. of Va., Richmond
 Hullibarger, William F., Jr., 5, 7 324 Tareyton Lane, Portsmouth
 Hume, Dr. David M., 9 Med. Col. of Va. Hospital, Richmond 19
 *Humphreys, Dr. Mary E., 4 Mary Baldwin College, Staunton
 Humphreys, Miss M. Gweneth, 2 R.M.W.C., Lynchburg
 Hundley, Dr. Louis R., 4 V.M.I., Dept. of Biology, Lexington
 —Hunt, Harvey L., 5, 7, 1 1411 N. Shore Dr., Norfolk
 —Hunter, Louise S., 2 Va. State College, Petersburg
 Hunter, Dr. W. L., 5 103 Penn St., Blacksburg
 Hurley, John F., 10 1609 Pinewood St., Falls Church
 Hurst, David C., 12 Dept. Statistics, V.P.I., Blacksburg
 Husted, Dr. Ladley, 4 Dept. of Biology, U. of Va., Charlottesville
 —Hyde, Dr. Austin T., Jr., 4 Rutherford Hospital, Rutherfordton, N. C.
 Ikenberry, Dr. Emmert, 2 310 West View St., Harrisonburg
 —Inge, Dr. Frederick D., 4 Hampton Institute, Hampton
 Ingersoll, Everett H., 9 MCV Station, Richmond 19
 —Ingles, Andrew L., 4 1006-3rd St., West Radford
 —Insley, Dr. E. G., 5 1233 Brent St., Fredericksburg
 —Irby, Richard, Jr., 5 712 Spottswood Rd., Richmond
 Jackson, Auzville, Jr., 7 Robertshaw-Fulton Controls Co.,
 1701 Byrd Ave., Richmond 26
 Jackson, Mrs. Caroline Goode, 4, 9 Dept. of Biology & Genetics,
 MCV Station, Richmond 19
 —Jackson, Mrs. David A., 4 Longwood College, Farmville
 Jacobs, Prof. James A., 2 Physics Dept., V.P.I., Blacksburg
 James, Dr. G. Watson, III, 9 MCV Station, Richmond 19
 Jarrard, Dr. Leonard E., 10 Wash. & Lee Univ., Lexington
 —Jeffers, Dr. George W., 4, 11 Rt. 6, Farmville
 Jefferson, Miss Betty Lou, 11, 4 1211 Forest St., Danville
 Jeffreys, Dr. A. W., Jr., 10 Western State Hospital, Staunton
 Jenkins, Dr. Marie M., 4 Box 188, Madison College, Harrisonburg
 Johnson, Charles C., Jr., 5, 2 P. O. Box 211, Chuckatuck
 Johnson, James A., Jr., 5 1101 State Office Bldg., Richmond 19
 —Johnson, Rose Mary, 4 Dept. Biology, Mary Washington Col.,
 Fredericksburg
 Johnson, Whitney L., 12 Dept. of Statistics, V.P.I., Blacksburg
 Johnston, Dr. Robert A., 10 Box 255, U. of Richmond, Richmond
 —Jones, A. Roland, 2 151-A Route 1, Glasgow

- Jones, Prof. Duvall A., 4 Ferrum Junior College, Ferrum
- Jones, Dr. E. Ruffin, 4 Dept. of Biology, U. of Fla., Gainesville, Fla.
- Jones, George D., 1, 4 309 Caroline St., Orange
- Jones, Johnnie A., Jr., 11 2464 Princess Anne Rd., Norfolk 4
- Jones, J. Claggett, J., 5 3906 Paterson Ave., Richmond 21
- Jones, Mrs. Louise L., 9 MCV Station, Richmond 19
- Jones, Muriel M., 3 MCV Station, Richmond 19
- Jones, William F., 4 251 Cantrell Ave., Harrisonburg
- Jopson, Dr. Harry G. M., 4 Bridgewater College, Bridgewater
- Joyce, Charles P., 8, 7 RFD 2, Farmville
- Joyner, Dr. W. T., 2 Phys. Dept., Hampden-Sydney Col.,
Hampden-Sydney
- Kapp, Mary E., 5 901 W. Franklin St., Richmond 20
- Kaster, Dwight L., 1 334 South Main St., Manassas
- Kay, Dr. Saul, 9 MCV Station, Richmond 19
- Kaye, Dr. Sidney, 9, 5 Dept. of Pathology, Hospital Municipal,
Rio Piedras, Porto Rico
- Keach, Charles C., 10 2531 Holmes Run Dr., Falls Church
- *Kean, Dr. Robert H., 5 32 Old Farm Rd., "Bellair", Charlottesville
- Keeble, Prof. W. H., 2 Box 607, Ashland
- Keefe, William, C., 4, 2 4612 Hanover Ave., Richmond 26
- Kell, Dr. Joseph F., Jr., 9 404 Professional Bldg., Richmond 19
- Kelly, Dr. M. Mae, 10 Madison College, Harrisonburg
- Kelly, Robert F., 11, 8 58 West Twin Lake Rd., Virginia Beach
- Kent, Mrs. Cleo Q. Naruna, Campbell Co.
- Kent, Prof. George W., 10 Bridgewater
- Kepner, Dr. William A., 4 29 University Place, University
- Keys, Noel W., 10 Dept. of Psychology, U. of Richmond
- Kindred, Dr. J. E., 9 Box 1873, Univ. Sta., Charlottesville
- King, Irving R., 2 8207 Penobscott Rd., Richmond 27
- King, Dr. Kendall W., 3, 4 Dept. of Biochem. & Nutri., V.P.I.,
Blacksburg
- Kipps, M. S., 1 103 Cohee Rd., Blacksburg
- *Kise, Dr. M. A., 5 Va. Chemicals & Smelting Co., West Norfolk
- Kizer, Franklin D., 11 7711 Woodman Rd., Richmond 28
- Knighton, Dr. Holmes T., 9 School of Dentistry, MCV Sta.,
Richmond 19
- Koch, Charles J., 1 7404 Birchwood Rd., Richmond 29
- Koppel, Leopold, 5 16 West St., Fort Plain, N. Y.
- Kosztarab, Dr. Michael, 4 Dept. of Entomology, V.P.I., Blacksburg
- Kounnas, Chris N., 5 2707 Grove Ave., Richmond 20
- Kozak, Samuel J., 8 Dept. of Geology, Wash. & Lee Univ., Lexington
- Kramer, Clyde Y., 12 Dept. of Statistics, V.P.I., Blacksburg
- Kreshover, Dr. Seymour J., 9 5206 West Cedar Lane, Bethesda, Md.

- Kriegman, Mrs. Lois S., 10 26 Malvern Ave., Richmond 26
- Krug, Dr. Robert C., 5 Dept. of Chemistry, V.P.I., Blacksburg
- Kulthau, Dr. A. R., 2 1615 Hardwood Ave., Charlottesville
- Kunt, Mrs. Feriha S., 11, 5 St. Margaret's School, Tappahannock
- Kunz, Walter B., 5, 2, 6 American Viscose Corp., Marcus Hook, Penn.
- Kurzhals, Peter R., C, 7 332 Brightwood Ave., Hampton
- Lackey, Jacquelyn, 11, 4 3006 Kanmore Dr., Hampton
- Lacy, O. W., 10 Trinity College, Hartford 6, Conn.
- Lancaster, J. L., 6 416 17th St., N.W., Charlottesville
- Lancaster, Morton H., 5, 1 404 Glendale Dr., Richmond 29
- Landis, Maureen, C, 4 1612 Langhorne Rd., Lynchburg
- Lane, Charles F., 8 Longwood House, Farmville
- *Lane, E. H., President, 5 The Lane Company, Altavista
- LaPrade, J. L., 1, 4 P. O. Box 715, Chatham
- *Larew, Dr. Gillie A., 2 2301 Rivermont Ave., Lynchburg
- Larson, Dr. Paul S., 5, 9 Medical College of Virginia, Richmond
- Larus & Brother Company, B Attn: A. T. Webster, Secy.-Treas.,
Richmond 17
- Larus, C. D., 2 Larus & Bros. Co., 22nd & Cary St., Richmond
- Latham, R. E., 2, 11 Sci. Dept., Episcopal H. S., Alexandria
- Lawless, Dr. Kenneth R., 5 Cobb Chemical Lab., Charlottesville
- Lawrence, Robert V., 7 305 Ellett Dr., Christiansburg
- Lee, Dr. Claudius, 7 Box 157, Blacksburg
- Lee, Prof. Mary Ann, 2, 12 Sweet Briar
- Lee, Philip C., Jr., C, 4 Box 4641, V.P.I., Blacksburg
- Leeper, Mrs. Annie S., 5 6727 Stuart Ave., Richmond
- LeFevre, Dr. Cecil W., 4 402 Price Hall, V.P.I., Blacksburg
- Leffler, Esther, 5 Sweet Briar College, Sweet Briar
- Leftwich, Dr. William H., 10 Box 81, University of Richmond
- Lehman, James D., 11, 4 20 Reservoir Ave., Luray
- Leidheiser, Dr. Henry, Jr., 5, 2 2820 Grove Ave., Richmond 21
- Leighton, Dr. A. T., Jr., 9 Poultry Dept., V.P.I., Blacksburg
- Leonard, Robert B., 8 U. S. Geological Survey, Quality of Water
Branch, 801 Harrison St., Topeka, Kansas
- Leone, Dr. Louis A., 9 19 Brentwood Ave., Barrington, R. I.
- LeVan, Donald C., 8 112 Stratford Court, Charlottesville
- Levin, Neal T., 5 118 Norman Rd., Newark 6, N. J.
- **Lewis, Dr. Ivey F., 4 800 Rugby Rd., Charlottesville
- Lewis, Mrs. Karen I., 9 Box 3096, Univ. Sta., Charlottesville
- Lincken, Edgar E., 5 2505 Curtiss Dr., Bayside
- Lindsey, Joseph F., 7 Dept. of Ind. Engr., V.P.I., Blacksburg
- *Line, Dr. Lloyd E., Jr., 2 Texaco Experiment Inc., Richmond
- Linfield, Dr. B. Z., 2, 12 1324 Hill Top Rd., Charlottesville

- Linn, J. A., 11, 2 38 S. Twinlake Rd., London Bridge
Linney, Mrs. Dorothy P., 5 554 Almond Dr., Newport News
—Little, Edwin D., Jr., 5 Box 221, Hopewell
—Littleton, Dr. Leonidas R., 5, 2 Emory
Loh, Hung-Yu, 2 Box 767, Blacksburg
—Lombardi, Gerado J., 7, 12 1705 Indiana, N.E.,
Albuquerque, N. M.
Long, Dr. John H., 2 176 Dennis Dr., Queen's Lake, Williamsburg
Long, John M., 2, 12, 6 School of Medicine, Univ. of Arkansas,
Little Rock, Ark.
Lowry, W. D., 8 206 Rose Ave., Blacksburg
Lucas, J. Richard, 7, 8 102 Holden Hall, V.P.I., Blacksburg
—Lundquist, Dr. Eugene, 2 P. O. Box 462, Hampton
Lunsford, Dr. Carl D., 5, 9 A. H. Robins Co., 1407 Cummings Dr.,
Richmond 20
Lutz, Robert E., 5 Cobb Chemical Lab., U. of Va., Charlottesville
Lyons, Dr. Harry, 9 MCV Station, Richmond 19
MacDougall, Capt. Hugh, 10, 8, 4 F.U.M.A., Fork Union
Macon, Evelyn T., 11, 4 1110 Griffin St., Lynchburg
Maguran, Gene A., Sr., 4, 2, 5 State Dept. of Edu., 11th and
Court Sts., Lynchburg
Mahan, Dr. John G., 4 Lynchburg College, Lynchburg
Major, Dr. Randolph T., 5 Cobb Chemical Lab., U. of Va.,
Charlottesville
**Manahan, Dr. John E., 2, 4 Scottsville
Mandell, Alan, 11, 4 P. O. Box 64, Frederick College, Churchland
Mankin, W. D., 4 Herndon
Mantey, W. F., Jr., 5 5403½ Queensbury Rd., Richmond 26
Mapp, John A., 10, 6 1924 Octavia St., New Orleans 15, La.
Margolena, Mrs. Lubow A., 4, 1 A.R.S. Animal Husb. Div., U.S.D.A.
Beltsville, Md.
Margolis, Dr. George, 9 Dept. of Pathology, MCV Sta., Richmond 19
Markees, D. G., 4, 5 Dept. of Chemistry & Physics, Wells College,
Aurora, N. Y.
Marlowe, Dr. Thomas J., 9 Animal Husb. Dept., V.P.I., Blacksburg
Maroney, Samuel P., Jr., 4 Dept. of Biology, U. of Va., Charlottesville
Martin, Dorothy A., 4 1116 Bedford Ave., Apt. 2, Norfolk 8
Martin, Dr. John W., 5 Bridgewater College, Bridgewater
—Martin, Dr. Walter B., 9 301 Medical Towers, Norfolk 7
Mason, Dr. A. H., 2 2407 N. Kenmore St., Arlington 7
Mason, Dr. John G., 5 Dept. of Chemistry, V.P.I., Blacksburg
Massey, Prof. A. B., 4, 1 Box 95, Blacksburg
Massey, Dr. P. H., Jr., 1 807 Gracelyn Court, Blacksburg
Matthews, T. L., Jr., 10 "Beechwood", Rt. 1, Box 216, Doswell

- Mattus, Dr. George, 1 Agri. Exp. Sta., V.P.I., Blacksburg
 May, Margaret L., 4 7432 Landsworth Ave., Richmond 28
 Maynard, William R., Jr., 5 1600 Michaels Rd., Richmond 29
 Mays, Gilbert, 11 State Dept. of Edu., Richmond
 McClurkin, John I., 4 R.M.C., Ashland
 McCrackan, Prof. Robert F., 5 41 Mill Rd., Spartanburg, S. C.
 McDaniel, Dr. R. R., 2, 12 Va. State College, Petersburg
 McDarment, Capt. Corley, 4, 2 Rt. 1, Box 205, Eau Callie, Fla.
 McEwen, Dr. Nobel, 10 401 College Ave., Ashland
 McGehee, Dr. Frances, 10 2615 Rivermont Ave., Lynchburg
 McGuigan, F. J., 10 Psych. Dept., Hollins College, Hollins
 McHugh, Dr. J. L., 4 Div. of Biological Res., Bureau of Commercial
 Fisheries, Washington 25, D. C.
 McInteer, Warren H., 2 3100 Greencastle Rd., Burtonsville, Md.
 McKee, Betty A., 9 Apt. 2, 707 N. Colonial Ave., Richmond 21
 McKenna, Virgil V., 10 Dept. of Psych., Col. of Wm. & Mary,
 Williamsburg
 McKennis, Dr. Herbert, Jr., 9, 5 MCV Station, Richmond 19
 McKillop, L. D., 5 Box 117, Route 2, Glen Allen
 McPherson, Col. William L., 5, 6 1 Ingles Court, Blacksburg
 McShane, E. J., 2 209 Maury Ave., Charlottesville
 *Medical College of Virginia Richmond
 Meem, Dr. J. L., 7 School of Engineering, U. of Va., Charlottesville
 —Mellette, Dr. Susan J., 9 Box 728, MCV Sta., Richmond 19
 Mengebier, Dr. W. L., 4 Dept. of Biology, Madison College,
 Harrisonburg
 Messersmith, Donald H., 4 Box 663, Radford College, Radford
 Messmer, Rear Admiral W. L., 2 163 Ridgeley Circle, Norfolk 6
 Meyer, W. J., 1 3206 Landria Dr., Richmond 25
 Midyette, James W., Jr., 1 P. O. Box 228, Ashland
 Milici, Dr. Robert C., 8 2212 Wayne Ave., Charlottesville
 Miller, Dr. Edwin D., 4 200 Monument Ave., Harrisonburg
 Miller, G. Tyler, 6 Hillcrest, Madison College, Harrisonburg
 Miller, Dr. G. Tyler, Jr., 5 Box 146, Hampden-Sydney College,
 Hampden-Sydney
 Miller, Lawrence I., 1 Tidewater Research Station, Holland
 Miller, Dr. W. Schuyler Box 202, Ashland
 —Milliser, Fred R., 5 839 Jefferson Ave., Waynesboro
 Mitchell, Dr. Richard S., 8 Dept. of Geology, U. of Va., Charlottesville
 Mitchell, Wilson D., 8 8419 Gaylord Rd., Richmond 29
 Moiler, Dr. Elizabeth, 10 Sweet Briar College, Sweet Briar
 —Montgomery, Mrs. Dorothy D., 2 Hollins College, Hollins
 *Moody, Warren L., 5 5 North 6th St., Richmond 19
 Moomaw, Rawie P., 5, 7 1233 Floyd Ave., S. W., Roanoke 7

Moon, Dr. J. H., 9 Box 202, MCV Station, Richmond 19
Moore, Marian E., 4 Dept. Food & Nutri., V.P.I., Blacksburg
Moore, Robert C., 1 Blacksburg
Moore, Steward, 1 RFD 1, Raphine
Moran, Mrs. Leroy, 5 2552 Sweetbriar Ave., S.W., Roanoke
Moreland, Dr. J. Earl, 10 R.M.C., Ashland
—Morgan, Mrs. William J., 10, 6 Merrifield
—Morgan, Dr. William J., 10 Merrifield
Morris, Dr. H. M., 7 Box 37, Blacksburg
Morrow, Leonard, 4 The L. H. Bailey Hortorium, Cornell Univ.,
Ithaca, N. Y.
Mosby, Dr. Henry S., 4 Dept. Forestry & Wildlife, V.P.I., Blacksburg
Moschler, W. W., 1 V.P.I., Agronomy Dept., Smyth Hall, Blacksburg
—Moseley, John M., 5 108 N. Wilton Rd., Richmond 26
Moss, Donald, C, 4 Rt. 2, Box 165, Mineral
Mounter, L. A., 5 Box 877, MCV Station, Richmond 19
Moyer, D. D., 1 Poultry Dept., V.P.I., Blacksburg
—Mullen, Dr. James W., 2, 7 Box 1-T, Richmond 2
Murden, William P., 7 5022 Sangamore Rd., Washington 16, D. C.
Murphy, Dr. Nelson F., 7, 5 Box 104, Blacksburg
—Murphy, R. S., 5 2514 McRae Rd., Bon Air 35
Murray, J. J., Jr., 4 Dept. of Biology, U. of Va., Charlottesville
Murray, Dr. J. J., Sr., 4 6 Jordan St., Lexington
Myers, R H., 12 106 Cohee Rd., Blacksburg
***Negus, Dr. Sidney S., 5 4102 Wythe Ave., Richmond 21
Nelson, Bruce O., 4 1340 West 50th St., Norfolk
Nelson, Bruce O., 8 P. O. Box 721, Fruits, Colo.
—Nelson, Dr. Charles M., 9 906 West Franklin St., Richmond
Nelson, Dr. E. Clifford, 3, 9, 4 MCV Station, Richmond
Nelson, Prof. Wilbur A., 8 208 Magnolia Dr., Charlottesville
Nemuth, Dr. H. I., 9 2012 Monument Ave., Richmond 20
Neveu, Dr. Maurice, 5, 2 Sci. Bldg., Longwood Col., Farmville
—Newman, Lt. Col. James B., 2 445 Institute Hill, Lexington
***The Newport News Shipbuilding & Drydock Co., "B" Newport News
—Niemeyer, A. B., Jr., 5 85 Alywin Rd., Cradock, Portsmouth
Nordlie, Dr. Peter G., 10 Human Sciences Research, Inc.,
1408 N. Filmore St., Arlington 1
Norfolk & Western Railway Co., B Atten: Martin P. Burks, Roanoke 17
Norman, S. F., Jr., 5 709 Pinetta Dr., Richmond 37
Norment, C. Russell, Jr., 11, 5, 2 Ellerson
*Norris, Dan Earle B., 7, 2 P. O. Box 26, Blacksburg
Nuckols, J. T., III, 8, 7 P. O. Box 9138, Richmond 27
Nugent, T. I., 1 Box 2160, Norfolk

Nuwayser, Elie S., C, 5	105 Maple Ave., Richmond 26
—Obenshain, Dr. S. S., 8	Blacksburg
O'Donohue, Mrs. Cynthia H., 5	2903 Monument Ave., Apt. 2, Richmond 21
O'Donohue, W. J., Jr., 9	2903 Monument Ave., Apt. 2, Richmond 21
—Oglesby, Prof. E. J., 2	Box 1887, Univ. Sta., Charlottesville
Old, Mrs. James E., Jr., 4	P. O. Box 69, Point Harbor, N. C.
Oldham, A. M., 5	1507 Young St., Richmond 22
Olivier, Dr. Charles P., 2	521 North Wynnewod Ave., Narberth, Penn.
—O'Neill, Charles T.	P. O. Box 711, Charlottesville
ONEil, Mrs. Paul G., 2	4610 Stuart Ave., Richmond 26
Orcutt, Dr. F. S., 3, 4, 5	1305 Hillcrest Dr., Blacksburg
O'Rear, Charles Edward, 5	1101 State Office Bldg., Richmond 19
Osborne, Dr. J. Clark, 7	Dept. of Veterinary Sci., V.P.I., Blacksburg
Osborne, J. Scott, Jr., 5	8719 Old Spring Rd., Richmond 25
Osborne, Dr. Paul J., 4	Lynchburg College, Lynchburg
Osborne, W. Wyatt, 4	Dept. Plant Pathology, V.P.I., Blacksburg
Oswalds, Dr. V., 2	P.O. Box 3445, Univ. Sta., Charlottesville
—Overby, A. W., 11	2408 Myrtle Ave., Norfolk 4
Overcash, H. B., 4	Hampden-Sydney
Owen, Dr., Fletcher B., Jr., 9, 5	1407 Cummings Dr., Richmond 20
Packard, Charles E., 4	501 S. Center St., Ashland
Packer, Margaret C., 11, 2	Chatham Hall, Chatham
Pallotta, Dr. Arthur J., 5, 9	Biometrics Research Lab., Inc., Box 26, Falls Church
Pardue, Dr. Louis A., 2	1005 Airport Rd., Blacksburg
Pare, Edward E., 2	Old Dominion College, Norfolk 8
Parker, M. M., 1	Box 2160, Norfolk
Parrott, W. T., 8	2015 Montagu Dr., Bon Air 35
Parsons, Dr. William A., 7, 5	104 Highland Ave., Blacksburg
Partlow, Benjamin W., 5	Box 518, Madison Col., Harrisonburg
Patterson, Dr. John L., Jr., 9	Box 282, MCV Station, Richmond 19
Patterson, Dr. Paul M., 4	Hollins College, Hollins
Patton, James B., Jr., 6	State Dept. of Edu., State Office Bldg., Richmond
Paul, Lee E., 10	M & S, FEA, Fort Lee
Peabody, Dr. William A., 5, 9	4805 Brook Rd., Richmond
Pearman, Jacqueline F., 9	P. O. Box 465, Mechanicsville
Pearman, Thomas B., 5	Box 465, Mechanicsville
Pedersen, P. M., 5, 2, 7, 12	4712 New Kent Rd., Richmond 25
Pegau, Lucy Byrd, 4	1808 Winston Rd., Charlottesville
—Perkins, Mrs. Frances R., 11, 2	7704 Hampshire Rd., Richmond 29

- Pertzoff, Dr. V. A., 2 1820 Edgewood Lane, Charlottesville
- Perry, I. Blairyne, 11 138 Union St., Hampton
- Perry, John L., 2 216 Fairlawn Ave., Norfolk 12
- Perry, Mrs. Virginia W., 12 515 Jefferson Ave., Hopewell
- Peters, Capt. Philip B., 2 Dept. of Physics, V.M.I., Lexington
- Petterson, Olga M., 9 Box 727, MCV Station, Richmond
- Pettus, William G., 2 410 Riverside Dr., Lynchburg
- Phillips, Dr. E. Lakin, 10 415 E. Jefferson St., Falls Church
- Phillips, Mrs. Margaret C., 2 114 Conway Ave., Norfolk 5
- ***Philip Morris & Co. Ltd. Inc., B Attn: Helmut Wakeham, Div.
of Res., P. O. Box 1895, Richmond 15
- Phipps and Bird, Inc., B 303 South 6th St., Richmond
- Pickral, Col. George M., 5 501 Brooke Lane, Lexington
- Pierce, Dr. J. Stanton, 5 813 Roseneath Rd., Richmond 21
- Pinschmidt, William C., Jr., 4 3206 Normandy Ave., Fredericksburg
- Pitt, Lyndeale A., 4, 5, 11 4303 New Kent Ave., Richmond 25
- Pittman, Dr. Melvin A., 2 Col. of Wm. & Mary, Williamsburg
- Pitts, Prof. Frank P., 5 Medical College of Va., Richmond
- Pitts, Dr. Grover C., 9 Dept. of Physiology School of Medicine,
University of Virginia, Charlottesville
- Pleasant, Miss Beverly A., 4 Box 388, Madison College, Harrisonburg
- Poates, Francis W., 11 Box 313, Chester
- Porter, H. C., 1, 8 1400 Crestview Dr., Blacksburg
- Potter, Katherine K. Marion Jr. H. S., Marion
- Potter, Dr. Lawrence M., 5, 1 400 Giles Rd., Blacksburg
- Powell, James R., c, 4 Dept. of Biology, V.P.I., Blacksburg
- Powell, Dr. W. Allan, 5 Box 86, U. of Richmond, Richmond
- **Powers and Anderson 603 E. Main St., Richmond
- Powley, Prof. George R., 7 503 Airport Rd., Blacksburg
- *Wm. P. Poythress & Co., Inc., 5, 9 Attn: A. G. Richardson
Chief Chemist, Box 2158, Richmond 17
- Preston, L. W., Jr., 12 1407 Cummings Dr., Richmond 20
- Price, Nelson O., 5, 9 107 Wharton St., Blacksburg
- Pugh, Jean E., 4 Old Dominion College, Norfolk 8
- Pullen, Dr. E. W., 9 Dept. Anatomy, U. of Va. Medical School,
Charlottesville
- Pulliam, Miss Elizabeth, 3 3516 Stuart Ave., Apt. 1, Richmond 21
- Quarles, Dr. Lawrence R., 7 Thornton Hall, U. of Va., Charlottesville
- Rabinowitz, David, 8, 4, 2 839 14th St., Newport News
- Rageot, Roger Norfolk Museum of Art & Sciences, Norfolk 10
- *Ragland, Richard S., 2 6252 S. Glenoakes St., (855 E), Murray 7, Utah
- Ramey, Dr. Robert L. Thornton Hall, U. of Va., Charlottesville
- Remsburg, Mrs. Vera B., 4 284 Locust St., Herndon

- Ramsey, E. W., 8 7557 Marilea Rd., Richmond 25
- Ramsey, John B., Jr., 2, 7 1420 Abingdon Dr., Apt. 201, Alexandria
- Ramsey, Mrs. Myra T., 11 Box 272, Route 4, Madison Heights
- Ramsey, M. M., 8 126 Observatory Ave., Charlottesville
- *Randolph-Macon Woman's College Lynchburg
- Randolph, W. B. F., 5, 3 2813 Keller Ave., Norfolk 9
- Rappaport, Dr. Jacques, 4 Miller School of Biology, Charlottesville
- Rasberry, Stanley D., C, 2 6309 64th Ave., Apt. 3, East Riverdale, Md.
- Ratchford, Dr. J. Thomas, 2 Dept. of Physics, Wash. & Lee Univ.,
Lexington
- Rayburn, Dr. C. H., 5 5212 Devonshire Rd., Richmond
- Redd, John B., Jr., 4 Box 43, Powhatan
- Redden, Prof. J. A., 8 Geology Dept., V.P.I., Blacksburg
- Reeves, Major John H., 4 Biology Dept., V.M.I., Lexington
- Reid, Dr. J. Douglas, 3 Univ. Heights, R.F.D. 13, Richmond
- Reitz, John E., 4 1414 Gordon Ave., Charlottesville
- *Rennie, C. Bruce, 1, 7, 5 Virginia-Carolina Chemical Corp.,
401 East Main St., Richmond
- *Rennie, James G., Jr., 2 1202 Confederate Ave., Richmond 27
- Reyes, Dr. Benjamin de los, 2, 11 Longwood College, Farmville
- Reynolds, Charlotte Frances, C, 4 Star Route, Chatham
- Reynolds Metals Company, B Attn: Mr. R. S. Reynolds, Jr.,
6601 West Broad St., Richmond 30
- Rex, Alan, C, 4 Box 5308, Va. Tech Sta., Blacksburg
- Rice, Dr. Nolan E., 4 Box 169, Univ. of Richmond, Richmond
- Rich, Dr. C. I., 1 Box 481, Blacksburg
- Rich, Dr. Gilbert J., 10N..... 406 Allison Ave., S.W., Roanoke
- Richards, Walter L., Jr., 4 1502 Cedar Lane, Richmond 25
- Richardson, Dr. Annie L., 4 Norfolk Div., Va. State Col., Norfolk
- Richardson, Ruth E., 11, 2 2825 Midlothian Pike, Richmond 24
- Richardson, Prof. W., 2 401 Roanoke St., Blacksburg
- Ridley, Bromfield L. Dept. of Biology, V.M.I., Lexington
- Risley, Miss A. Marguerite, 2 Box 63, R.M.W.C., Lynchburg
- Rison, J. Waddell 1008 Mutual Bldg., Richmond 19
- Ritchey, Col. H. E., 5 213 Maiden Lane, Lexington
- Ritt, Dr. Paul E., 5 300 Arlington Blvd., Falls Church
- Rittenbury, Dr. Max S., 9 8327 Whitewood Rd., Richmond 25
- Roane, Curtis W., 1, 4 Dept. Plant Pathology & Physiology, V.P.I.,
Blacksburg
- Roberts, Clarence E., 8 265 Richneck Rd., Denbigh
- Roberts, Dr. Joseph K., 8 Box 528, Hartsville, S. C.
- Roberts, J. W., 7 3204 Hawthorne Ave., Richmond 22
- Roberts, Dr. Phyllis S., 9, 5 608 Gaskins Rd., Richmond 29
- Robeson, Dr. Andrew, 2 Kelsey Lane, Blacksburg

- Robey, Dr. Ashley, 5 P. O. Box 421, Salem
- Robinowitz, David, 7, 4, 9 301 Emmet House, U. of Va.,
Charlottesville
- A. H. Robins Company, Inc., B 1407 Cummings Dr., Richmond 20
- Robinson, Walter E., 11, 5 1901 Effingham St., Portsmouth
- Rodger, E. E., 1 1427 Gentry Lane, Charlottesville
- Rodig, Dr. Oscar R., 5 Cobb Chemical Lab., U. of Va., Charlottesville
- Rose, Barbara, C, 4 1713 Meadowbrook Rd., Charlottesville
- Rose, Dale E., 11, 5 Box 448, Hampton City Schools, Hampton
- Rosenblatt, Prof. David, 12, 4, 2 4220 Columbia Pike, Arlington 4
- Rosenblatt, Dr. Joan Raup, 12 4220 Columbia Pike, Arlington 4
- Ross, Robert R., 4 614 Airport Rd., Blacksburg
- Ross, Sam J., Jr., 1 P. O. Box 113, Madison
- Rosser, Shirley E., 2 Lynchburg College, Lynchburg
- Row, Dr. Stuart B. 206 Eakin St., Blacksburg
- Rowe, Dr. Frederick B., 10 2209 Rivermont Ave., Lynchburg
- Rowe, Maurice B., 1 Room 304, 203 Governor St., Richmond 19
- Rowell, Dr. J. O., 4 305 Price Hall, V.P.I., Blacksburg
- Rowlett, Dr. Russell J., Jr., 5 4606 Wythe Ave., Richmond
- Rozsa, Dr. George, 9, 5 6 Lexington Ave., Buffalo 22, N. Y.
- Rudolph, Dr. Rosser A., Jr., 5 1100 Meadow Dr., Ellersson
- Rucker, Isabelle P., 11 State Dept. of Education, Richmond
- Runk, Dean B. F. D., 4 Box 3727, Univ. Sta., Charlottesville
- Russell, Dr. Catherine M., 3 Dept. of Micro-Biology, Univ. of Va.
Medical School, Charlottesville
- Russell, Edgar V., Jr., 5 Dept. of Chemistry, V.P.I., Blacksburg
- Ryman, Jacob F., 2 Box 147, Blacksburg
- Sacks, Dr. Jerome H., 9 Box 273, MCV Station, Richmond 19
- Sadle, Dr. Alexander, 5 Nitrogen Div., Allied Chemical and
Dye Corp., Hopewell
- Sadler, O. P., 11 Buckingham Central H. S., Buckingham
- Sadler, Mavis Marlene, 4 Route 2, Wytheville
- Said, Dr. Sami I., 9 Dept. of Medicine, MCV Station, Richmond 19
- Samuel, Boyd L., 5, 1 1101 State Office Bldg., Richmond 19
- Sanders, Jerrell, 2 1546 Berkeley Ave., Petersburg
- Sanger, Dr. Wm. T., 9, 10, 6 Medical College of Va., Richmond
- Sauder, Major William C., 2 248 Stanmore Rd., Baltimore 12, Md.
- Savedge, Major C. E., 11 P. O. Box 7, Fort Defiance
- Scherer, Dr. J. H., 9 820 W. Franklin St., Richmond
- Scherer, W B., 10 Box 6113, Richmond 22
- Schillo, Richard J., 10 517 Valley Dr., S.E., Vienna
- Schmidt, R. C., 5 Box 5262, Richmond
- Schneider, Dr. Joseph I., 5 127 Hesketh St., Chevy Chase, Md.

- Schoenbaum, Alexander W., 5, 7 403 Beechwood Dr., Richmond
- Schwager, Robert G., 4 Biology Dept., U. of Va., Charlottesville
- Scott, Frances Deane, 10, 6 Woodstock Apt. 12, Lynchburg
- Scott, Frederic R., 4, 2 115 Kennondale Lane, Richmond 26
- Scott, Marvin W., 4 Longwood College, Farmville
- *Scott and Stringfellow Richmond
- Scott, Dr. William W., 4 Dept. Biology, V.P.I., Blacksburg
- Sears, C. E., 8, 7 Box 522, Blacksburg
- Sears, Dr. D. Scott, 5 8131 Sawmill Ave., Richmond 29
- Seligman, Dr. Robert B., 5 Box 3-D, Richmond 6
- Seymour, Roland, 4 Dept. of Biology, V.P.I., Blacksburg
- Sharpley, J. M., 3 Box 846, Fredericksburg
- Shelburne, Tilton E., 7, 8 Box 3817, Univ. Sta., Charlottesville
- Shelton, George E., 5 Box 6-S, Richmond 17
- Shepherd, Mary G., 11, 5, 4 1643 Center Hill Dr., S.W., Roanoke
- Sheppard, Dr. L. Benjamin, 9 301 Medical Arts Bldg., Richmond
- Sherwod, C. S., III, 5, 6, 8 111 West Rd., Portsmouth
- Shillington, Dr. James K., 5 Box 557, Lexington
- Sholes, Dr. Dillard M., Jr., 5, 9 203 West G, Elizabethton, Tenn.
- Shuey, Dr. Audrey M., 10 1059 Rivermont Ter., Lynchburg
- *Shufflebarger, T. E., Jr., 8 606 Middy Lane, Alexandria
- Siegel, Dr. Herbert S., 1 Poultry Dept., Va. Agr. Exp. Sta., Blacksburg
- Siegel, Dr. Paul B., 1 School of Agriculture, V.P.I., Blacksburg
- Silas, Dr. Gordon, 10 Roanoke College, Salem
- Silverberg, Dr. Jacob, 10 2706 Melbourne Dr., Richmond 25
- Simmons, Roberta K., 10 1102 Colonial Ave., Norfolk
- Simpkins, Pocahontas, C, 4 Box 1066, Radford Col., Radford
- Simpson, Dr. R. L., Jr., 9 Medical Col. of Va., Richmond 19
- Simpson, Dr. T. McN., Jr., 2 Ashland
- Singleton, O. R., Jr., 7 14 Lexington Rd., Richmond 26
- Singleton, Dr. W. Ralph, 4 Dept. of Biology, U. of Va.,
Charlottesville
- Sinnott, Allen, 8 32 Merritt Dr., Trenton, N. J.
- Skinner, W. French, 3, 9 5702 York Rd., Richmond 26
- Slocum, Robert R., 2 Col. of Wm. & M. in Norfolk,
Hampton Blvd. & Bolling Ave., Norfolk
- Sloope, Billy W., 2 8718 Avalon Ave., Richmond 29
- Smart, Col. C. W., 5 449 Institute Hill, Lexington
- Smart, Grover C., Jr., 4 Tidewater Research Sta., Holland
- Smart, Dr. Robert F., 4, 2 Dean's Office U. of Richmond
- Smiddy, Joseph C., 4 Clinch Valley College, Wise
- Smiley, Mrs. Janet S., 11 Box 401, Yorktown
- Smith, Alvin H., 10, 6 Hampden-Sydney Col., Hampden-Sydney
- Smith, Bessie S., 10 26 Elm St., Newport News

Smith, Dr. Burke M., 10 1649 Brandywine Dr., Charlottesville
—Smith, Foley F., 5, 9, 1 Box 1420, Richmond
Smith, Garland W., 7 4710 Laurie Lane, Richmond 23
Smith, Harry L., 1, 4 3404 Martin Ave., Richmond
Smith, Howard C., C, 4 Biology Dept., U. of Va., Charlottesville
Smith, Dr. J. Doyle, 5 Medical Col. of Va., Richmond
Smith, Pauline, 11 Route 2, Box 434, Manassas
*Smith, R. Blackwell, 9 606 MCV Sta., Richmond, 19
Smith, Robert L., 5 940 West Teak St., Brea, Calif.
Smithey, Dr. William R., Jr., 5 Research Dept., Virginia-Carolina
Chemical Corp., Richmond
Smyth, Mrs. Mary L., 4 Box 144, Blacksburg
Snead, Mrs. Ellis Pollard, 11, 4 Carysbrook
Snieszko, Dr. S. F., 3, 4 Kearneysville, W. Va.
Snyder, Maywood, 5 Southern States Cooperative, Richmond
Sommerville, Dr. R. C., 10 307 Vernon St., Lynchburg
S.O.S. Science Club Bedford High School, Bedford
Sonenshine, Dr. Daniel E., 4 Biology Dept., Old Dominion Col.,
Norfolk 8
Sorensen, Harold F., 10 8001 Crescent Rd., Norfolk 8
Southern Materials Co., Inc., B Attn: E. M. Gourley, Vice-
President, Norfolk 1
Speidel, Dr. Carl C., 9, 4 Dept. of Anatomy, Medical School,
University of Virginia, Charlottesville
Spencer, Dr. Edgar W., 8 Geology Dept., Wash. & Lee Univ., Lexington
Sprague, Elizabeth F., 2 Sweet Briar College, Sweet Briar
Spraker, James H., 4 8903 Watlington Rd., Richmond 29
Stanback, Mrs. B. A., 11, 4 1415 Ellington Square, Portsmouth
Stapelkamp, Mrs. Joan L., 5 Resetarch Lab., American Tobacco Co.,
400 Petersburg Pike, Richmond 24
Starling, Dr. James, 4 Main St., Lexington
State Planters Bk. of Commerce & Trusts Atten: Rawley F. Daniel, B,
Richmond 14
Steinhardt, R. G., Jr., 5, 2 Hollins College, Hollins
Stern, Dr. E. George, 7 Box 361, Blacksburg
Stevens, Eleanor B., 11, 2, 5, 4 Foxcroft School, Middleburg
—Stevens, Dr. Kenneth P., 9, 4 404 E. Nelson St., Lexington
—Stevenson, Dr. Edward C., 2 Box 1893, Univ. Sta., Charlottesville
Stewart, Frank B., 1 P. O. Box 2160, Norfolk
Stewart, John W., 2 Dept. of Physics, McCormick Rd.,
Charlottesville
Stewart, Lawrence L., Jr., 5 3845 Caulder Court, Richmond 24
Stewart, Miss Roberta A., 5 Box 634, Hollins College, Hollins

- Stickney, Capt. Fred R., USN (Ret), 11, 5 P. O. Box 368, Berryville
- Stone, Mrs. Ruth M., 4, 2 81 Senca Ave., Yonkers, N. Y.
- *Strauss, Admiral Lewis L., 2, 1, 9 Brandy Farm, Brandy Station
- Strickland, Dr. John C., 4 Biology Dept., U. of Richmond, Richmond
- **Strudwick, Edmund, Jr. 800 Monument Ave., Richmond 20
- Suter, Daniel B., 4 Eastern Mennonite College, Harrisonburg
- Swem, Dr. Earl G., 6 2421 Glen Mary Ave., Louisville, Ky.
- *Sweet Briar College Sweet Briar
- Swertferger, Dr. Floyd F., 6, 10 Longwood College, Farmville
- Swezey, Dr. F. H., 5 Box 1071, Waynesboro
- Swink, E. T., 7 910 Preston Ave., Blacksburg
- Talley, Claude P., 5 3442 Northview St., Richmond
- Tatem, Charles E., 4 1301 W. 51st St., Apt. 2, Norfolk 8
- Taylor, Gerald R., Jr., 2 13 E. Copley Hill, Charlottesville
- Taylor, Henry M., 12 Ravenswod, 8718 River Rd., Richmond 26
- *Taylor, Jackson J., 2 U. of Richmond, Richmond
- Taylor, Dr. L. H., 1 Agronomy Dept., V.P.I., Blacksburg
- Taylor, Mabel K., 11, 4 9001 Thalia Dr., Lynnhaven
- Taylor, Dr. Mildred E., 2 Mary Baldwin College, Staunton
- Taylor, Dr. Raymond L., 4 1820 N. Johnson St., Arlington 7
- Teass, F. Alex, 4 239 S. Princeton Circle, Lynchburg
- Tebo, Dr. Edith J., 2 53 East End Ave., Shrewsbury, N. J.
- Temple, William T., 5 1712 Monticello Ave., Petersburg
- Tenney, Eleanor, 11, 4 1507 Cutshaw Place, Richmond 26
- Tenney, Dr. Wilton R., 3 Box 414, University of Richmond
- *The Texaco Experiment Inc. Box 1-T, Zone 2, Richmond
- Thalhimer, Morton G. 4 Paxton Rd., Richmond 26
- Thaxton, Mrs. Joe J., Jr., 11 746 Peaks St., Bedford
- Thomas, Herbert H., 1 5613 Coppedge Ave., Jacksonville, Fla.
- Thomas, Dr. John A., 9 Dept. of Pharmacology, U. of Va. Medical
School, Charlottesville
- *Thompson, Prof. Claude C., 2 Dept. of Mathematics, Hollins College
- Thompson, Dr. Dorothy D., 5 Box 32, Sweet Briar College, Sweet Briar
- Thompson, Ertle, 5, 11 1810 Chelsea Dr., Charlottesville
- Thompson, Frank E., Jr., 11, 4 4520 Newport St., Richmond
- Thompson, Jesse C., 4 Biology Dept., Hollins College, Hollins
- Thompson, Norman R., 4 Dairy Sci. Dept., V.P.I., Blacksburg
- *Thompson, Dr. W. T., Jr., 9 MCV Hospital, Richmond, 19
- *Thomsen, Dr. Lillian, 4 Mary Baldwin College, Staunton
- Thornton, Dr. Nan V., 5 Box 292, RMWC, Lynchburg
- Thornton, Dr. S. F., 1 P. O. Box 1940, Norfolk
- Thurmaier, Dr. Roland Joseph 2514 Cortland St., Waynesboro
- Tischler, Morris S., 11, 5 George C. Marshall H. S., 2323 Lees-
burg Pike, Falls Church

- Tobler, Henry, III, 11, 2 45 Grattan St., Harrisonburg
- Toker, William J., 2 Dept. of Physics, V.M.I., Lexington
- Tolbert, Dr. E. L., 10 Madison College, Harrisonburg
- Toone, Dr. Elam C., Jr., 9 1200 East Broad St., Richmond
- Totten, A. I., Jr., 7 Reynolds Metal Co., 1519 Summit Ave., Richmond
- Townsend, Dr. J. Ives, 4, 9 Dept. of Biology & Genetics, MCV
Station, Richmond 19
- Trainer, Frank W., 8 U. S. Geological Survey, Water
Resources Division, Washington, D. C.
- Trout, Dr. William E., Jr., 5 Box 216, U. of Richmond, Richmond
- Trout, William E., III, C, 4 Dept. of Zoology, Indiana University,
Blomington, Indiana
- Troutman, Joseph L., 1 Va. Agri. Expt. Sta., Chatham
- Truitt, Prof. R. W., 7 Mech. Engr. Dept, North Carolina State
College, Raleigh, N. C.
- Tucker, Capt. John R., 2 Dept. of Physics, V.M.I., Lexington
- Turner, Edward F., Jr., 2 23 University Place, Lexington
- Turner, Dr. J. V., Jr., 9 804 Professional Bldg., Richmond
- Turner, Dr. Malcolm E., 12 7007 Lakewood Dr., Richmond 29
- Ulrich, Dale, 2 506 7th Street, N.E., Charlottesville
- *University of Richmond Attn: Dr. Charles Wheeler,
University of Richmond, Richmond
- Updike, Dr. O. L., Jr., 7, 5 Thornton Hall, Univ. of Va.,
Charlottesville
- Updike, Dr. I. A., 5, 6 304 Henry St., Ashland
- Updike, Dr. Winifred W., 5 304 Henry St., Ashland
- Uttal, Leonard J., 1 Route 3, Madison Heights
- Valentine, C. Braxton, 5, 9 Box 7306, Richmond 21
- Valentine, Granville G., Jr., 5, 9, 3 Box 7306, Richmond 21
- VanEngel, Willard A., 4 Va. Inst. of Marine Sci., Gloucester Point
- Varnier, H. E., 7 3510 Clydeswood Ave., Richmond 24
- Varsef, Charles, 5 7825 Granite Hall Ave., Richmond 25
- Vaughan, Dr. W. S., Jr., 10 1407 Alice Court, Falls Church
- Via, Bety Carolyn, 4 2228 Carter Rd., Roanoke
- Vingiello, Dr. Frank A., 5 107 Monta Vista Dr., Blacksburg
- Virginia-Carolina Chemical Corp., B Research Department Library,
Box 1136, Richmond 8
- Virginia Chemicals & Smelting Co., B Attn: Dr. M. A. Kise, Dir. of
Research, West Norfolk
- *Virginia Military Institute Lexington
- *Virginia Polytechnic Institute Library Blacksburg
- Volk, Dr. Wesley A., 4 Dept. of Microbiology, School of Med.,
University of Virginia, Charlottesville
- Wagner, John R., 5 15002 Peachstone Dr., Silver Springs, Md

- Walker, Frank S., Jr., 1 Rosni Farms Inc., Orange
- Walker, Dr. Paul A., 4 Dept. of Biology, R.M.W.C., Lynchburg
- Walker, R. J., 9, 1, 6 P. O. Box 313, Newport News
- Walker, Dr. Richard D., 7 Dept. of Civil Eng., V.P.I., Blacksburg
- Wallace, Donald S., 7 Box 3094, University Sta., Charlottesville
- Wallerstein, Dr. Emanuel U., 9 Profesional Bldg., Richmond
- Walsh, Mrs. Martha L. 1819 Chesterfield Ave., McLean
- Walton, Clarence R., 3 1213 Greystone, Richmond 24
- Walton, Dr. Leon J., 9 713 Shenandoah Life Bldg., Roanoke
- Walton, Miss Lucile, 4 1116 East Main St., Danville
- Miss Margaret Walton 116 East Main St., Danville, Va.
- Ward, Dr. John W., 5, 9 A. H. Robins Co., Inc., 1407 Cum-
mings Dr., Richmond
- Ward, L. E., Jr., 1, 7 One Morris St., Apt. 408, Charleston, W. Va.
- Warren, C. O., Jr., 4 Biology Dept, V.PI Blacksburg
- Warren Dr. Percy H., 4 Madison College, Harrisonburg
- Warren, R. L., 5 Frederick College, Portsmouth
- Wartman, William B., Jr., 5 1020 Horsepen Rd., Richmond 29
- *Washington & Lee University Dr. William H. Hinton, Lexington
- Watkins, Miss Leslie V., 2, 4 419 Day Ave., S. W., Roanoke
- Watson, Douglas F., 9 109 Sunset Bulvd., Blacksburg
- Watson, Dr. William L., 1 Box 327, Va. State College, Petersburg
- Watt, Dr. William J., 5 Dept. of Chemistry, Wash. & Lee U.,
Lexingt
- Weaver, Miss L. M., 11, 2 Huntington High School, Newport News
- Weaver, Col. R. C., 2 404 V.M.I. Parade, Lexington
- Weaver, Dr. Warren E., 5, 9, 6 5910 Upham Dr., Richmond 27
- Webb, L. W., Jr., 2, 7 5234 Edgewater Dr., Norfolk 8
- Weeks, Edna M., 11 Box 614, Salem
- Weeks, Elie, 12 Chief, Food and Container Branch, QMR &
DFEA, Fort Lee
- Weems, Norman H., 4 Box 9, Frederick College, Portsmouth
- Weiland, Elizabeth M., 4 1320 Krise Circle, Lynchburg
- Weir, Dr. Robert J., 1 Hazelton Lab., Box 30, Falls Church
- Wells, Carolyn, 4 Dept. Biology, Longwood Col., Farmville
- Welch, Dr. Bruce L., 4 Dept. of Biology, Col. of Wm. and Mary,
Williamsburg
- West ,Warwick R., Jr., 4 Box 248, Univ. of Richmond, Richmond
- Westbrook, Dr. C. Hart, 10 17 Towana Rd., Richmond
- Westbrook, John James, III, 5 Box 574, Chester
- Whidden, Miss Helen L., 5, 2 Dept. of Chemistry, R.M.W.C.,
Lynchburg
- White, John E., 12 Bridgewater College, Bridgewater
- Whitehead, W. Dexter, Jr., 2 Physics Dept., U. of Va., Charlottesville

Quality



Products of *The American Tobacco Company*

"Tobacco IS OUR MIDDLE NAME"

Whitehurst, Prof. W. H., 4	Box 422, Lawrenceville
Whitlow, Arline, 11, 4	Route 1, Gladys
Whitney, Dr. George S., 5	P. O. Box 607, Lexington
Whittemore, Dean J. W., 6, 7	900 Draper Rd., Blacksburg
Whittenburg, Dr. John A., 10	6810 Jewel St., Alexandria
Whyburn, Gordon T., 2	Pavilion III, West Lawn, U. of Va., Charlottesville
Wickham, James E., Jr., 5, 4	604 John St., Ashland
Wightman, Dr. James P., 5	Chemistry Dept., V.P.I., Blacksburg
Wikswa, Mrs. Leonora A., 2	Box 241, Amherst
Wiley, Robert M., 5	900 Rutherford Rd., Richmond 25
Will, Prof. P. K., 7	Dept. Mech. Engr., V.P.I., Blacksburg
-Willey, C R., 4	Room 325, 203 N. Governor St., Richmond 19
Williams, Dr. A. S., 1	Dept. of Plant Pathology & Physiology, V.P.I., Blacksburg
**Williams, Dr. Carrington, 9	805 West Franklin St., Richmond 20
Williams, Emmett L., Jr.	Dept. of Metallurgical Engr., V.P.I., Blacksburg
**Williams, Lewis C., 6,1210	1309 State Planters Bank Bldg., Richmond 19
-Williams, Dr. Stanley B., 10	Dept. of Psych., Wm. & M. Col., Williamsburg
Williams, Mrs. Stanley B., 10	504 Newport Ave., Williamsburg
Williamson, T. G., 7	Dept. of Nuclear Engr., U. of Va., Charlottesville
Wills, Wirt H., 1, 4	Box 430, Chatham
Wilson, Dr. I. D., 9, 4, 1	1303 Oak Dr., Blacksburg
Wilson, John M., 8	1712 Jefferson Park Ave., Charlottesville
Wiltshire, Mrs. James W., Jr., 4	R.M.W.C., Lynchburg
Wine, Dr. R. Lowell, 12	Route 1, Box 311, Roanoke
Wingard, S. A., 4, 1	Box 425, V.P.I., Blacksburg
Wingfield, Dr. Harvey N., Jr., 9	Box 395, Rt. 1, Glen Allen
Wingo, Dr. Alfred L., 6, 5, 1, 10	State Board of Educ., Richmond
Winsten, Dr. Benjamin, 10	3015 West Ave., 1, Newport News
Winter, John A., 12	P. O. Box 206, Boalsburg, Penn.
Wise, E. Spencer, 11, 4	5106 Atlantic Ave., Virginia Beach
Wise, Dr., John H., 5, 2, 6	Dept. of Chem., W. & L. U., Lexington 6
Wisman, Dr. E. L., 5	Dept. of Biochem & Nutri, V.P.I., Blacksburg
Wood, Dr. John Thornton, 4, 9, 10	1528 Greenview Dr., Ann Arbor, Mich.
Wood, Robert S.	2401 Ruck St., New Orleans, La.
Woodland, Dr. John T., 4	113 Gainsboro St., Boston 15, Mass.
Woods, Dr. Paul J., 10	Hollins College, Hollins
-Woodson, Bernard R., Jr., 4	Va. State Col., Petersburg
Woolcott, William S., 4	Box 248, U. of Richmond, Richmond
Worrell, Eunafaye, 11	Route 1, Laurel Fork

**Representing
the
Most
Respected
Manufacturers
in the
Laboratory
Supply
Industry**

Corning Glass • Kimble Glass •
Coors Porcelain • Nalge Plastics
• Sheldon Furniture • Beckman
Instruments • Coleman Instru-
ments • American Optical Com-
pany • Bausch & Lomb, Inc. •
Eberbach Corporation • Inter-
national Equipment Company •
Burrell Corporation • Labora-
tory Equipment Company •
Ainsworth Balance • Ohaus
Balance • U.S. Stoneware •
J. T. Baker Chemicals • Mal-
linckrodt Chemicals • Matheson
Coleman & Bell Organics •
Precision Scientific Company •
Labline, Inc. • Thermolyne
Corporation • Buehler, Ltd. •
Baltimore Biological • Difco
Laboratories • Wm. Boekel &
Company • Humboldt Manufac-
turing Company • Hevi-Duty
Electric Company • W. A.
Taylor Company • Sartorius
Balance • Torsion Balance •
Hellige, Inc. • Plus Many
Others.

Serving the South for over 35 years

PHIPPS & BIRD, INC.



MANUFACTURERS AND DISTRIBUTORS OF SCIENTIFIC EQUIPMENT

6TH & BYRD STREETS — RICHMOND, VA.

PHONE MI 4-5401

- Worsham, James E., Jr., 5, 2 Box 27, U. of Richmond
- Wright, H. E., Jr., 5 5500 Queensbury Rd., Richmond
- Wright, Mary P., 5 1000 Pepper Ave., Richmond 26
- Yoe, Dr. John H., 5 Dept. of Chem., U. of Va., Charlottesville
- York, James E., Jr. 1006 Baywood Court, Richmond
- Youden, Dr. W. J., 12 Natl. Bur. of Standards, Washington 25, D. C.
- *Young, Dr. Fred W., Jr., 5 7213 Sheffield Dr., Knoxville 19, Tenn.
- Young, Dr. H. N., 1 Box 66, Blacksburg
- *Young, Dr. Nelson F., 5 Medical Col. of Va. Hospital, Richmond 19
- Young, Roderick W., 1 Box 66, Blacksburg
- Young, Dr. Robert S., 8 113 Bennington Rd., Charlottesville
- Zaneveld, Dr. Jacques S., 4 1334 Upper Brandon Pl., Norfolk
- Zipf, Dr. Elizabeth M., 4 316 Kingston Ave., Barrington, N. J.
- Zirkle, Leon F., 11, 2 715 Spruce St., Martinsville
- Zolik, Dr. Edwin S., 10 2605 Valley Dr., Alexandria
- Zuk, Dr. William, 7 Thornton Hall, U. of Va., Charlottesville
- Nauk, Filial Biblioteki Akademii, SSSR Balliysky Pos. 42-G,
Moscow D-219, USSR
- National Library of Medicine Washington 25, D. C.
- General Library Periodicals Recording Clerk, Southern
Illinois University, Carbondale, Illinois
- U. S. Dept. of Agriculture Animal Disease & Parasite Research Div.,
ARS, Beltsville Parasitological Lab., Beltsville, Md.
- Library The Arnold Arboretum, Harvard University,
Cambridge, Mass.
- Serials Division Harvard College Library, Cambridge 30, Mass.
- Order No. L-50909 S Michigan State College, Library Dept.,
East Lansing, Mich.
- Library Princeton University, Princeton, N. J.
- Acquisitions Division A. R. Mann Library, Ithaca, N. Y.
- The Library S American Museum of Natural History,
Central Park West at 79th St., New York City 24, N. Y.
- D. H. Hill Library North Carolina State College, Raleigh, N. C.
- R. J. Reynolds Tobacco Co. Research Dept.—Library Subs.,
Winston-Salem, N. C., U.S.A. No 58-19933
- Literature Acquisitions Dept. Biological Abstracts,
3815 Walnut St., Philadelphia 4, Penn.
- Foundren Library S. M. U., Dallas 5, Tex.
- George Mason Collection University of Virginia Library,
5836 Columbia Pike, Alexandria
- Butler, Frank Department of Accounting, School of Business,
V.P.I., Blacksburg
- Library Va. Inst. of Marine Science, Gloucester Point

Librarian	Hampden-Sydney College, Hampden-Sydney
Library	Va. State Col., 2401 Corprew Ave., Norfolk 4
Richmond Professional Inst.	Attn: Rosamond McCanless, Librn., 901 West Franklin St., Richmond 20
Richmond Public Library	101 East Franklin St., Richmond 19
Texaco Experiment Inc. Library	P. O. Box 1-T, Richmond 2
Mary Helen Cochran Library	Sweet Briar College, Sweet Briar
Prof. Joseph Zung, 5, 2	601 College Ter., Williamsburg
West Virginia University Library	V54814, Morgantown, W. Va.
McGill University Library	3459 McTavish St., Montreal 2, Quebec
Gos. Nauchn. Biblioteka	Minist. Vyssh. Obraz., Pl. Nogina, 2/5, Moscow USSR

BUSINESS MEMBERS
VIRGINIA ACADEMY OF SCIENCE

Albemarle Paper Manufacturing Company
Allied Chemical Corporation
The American Tobacco Company
Dan River Mills
The Dow Chemical Company
E. I. du Pont de Nemours and Company, Inc.
First and Merchants National Bank
General Electric Company
Larus and Brother Company, Inc.
The Newport News Shipbuilding Company Foundation
Norfolk and Western Railway Company
Philip Morris and Company, Limited, Inc.
Phipps and Bird, Inc.
Reynolds Metals Company
A. H. Robins Company
Southern Materials Company
State-Planters Bank of Commerce and Trusts
Virginia-Carolina Chemical Corporation
Virginia Chemicals and Smelting Company



INDEX

THE VIRGINIA JOURNAL OF SCIENCE

Volume 14 (New Series), 1963

Editor

Paul B. Siegel (Blacksburg)

Managing Editor

Carl W. Allen (Blacksburg)

with *Section Editors*

D. Rae Carpenter, Jr. (Lexington)	Astronomy, Mathematics, Physics
P. Arne Hansen (College Park)	Bacteriology
Jesse C. Thompson, Jr. (Hollins)	Biology
M. A. Kise (Norfolk)	Chemistry
N. F. Murphy (Blacksburg)	Engineering
W. T. Parrott (Petersburg)	Geology
W. P. Anslow, Jr. (Charlottesville)	Medical Sciences
W. H. Leftwich (Richmond)	Psychology
Allen Mandell (Norfolk)	Science Teachers
Clyde Y. Kramer (Blacksburg)	Statistics

Published by *The Virginia Academy of Science*
Blacksburg, Virginia

CONTENTS

NO. 1, JANUARY, 1963

Summer Programs Provide Science Study Opportunities for Virginia's High School Students. A. Mandell	1
A Spectrophometric Investigation of Iodine Trichloride in Carbon Tetrachloride. R. D. Whitaker and G. B. Fozzard	6
Some New and Unusual Fungi from Virginia. I. Lower Phycomycetes. W. W. Scott, R. Seymour and C. Warren	11
A Redescription of the Hymenostome Ciliate <i>Sathrophilus (Saprophilus) muscorum</i> (Kahl, 1931) Corliss, 1960, with Particular Attention to the Buccal Apparatus. J. C. Thompson and Margaret V. Cone	16

NO. 2, APRIL, 1963

The Absorption Spectrum of T-1824 Dye in Swine Plasma. J. D. Burke	37
Pure Culture Techniques Applied to the Growth of a <i>Saprolognia</i> spp. on a Chemically Defined Medium. W. W. Scott, J. R. Powell and R. L. Seymour	42
Some New and Unusual Fungi from Virginia. II. Aquatic Hyphomycetes. W. W. Scott and C. J. Umphlett	47
Program of the Forty-Second Meeting	79

NO. 3, JULY, 1963

<i>Dictyota dichotoma</i> in Virginia. Harold J. Humm	109
---	-----

Determining Resources Needed in Virginia Agriculture in the Years Ahead. Carl W. Allen	112
The Nesting of the Many-Lined Salamander in the Dismal Swamp. J. T. Wood and R. H. Rageot	121
The Generic Significance of the Buccal Infraciliature in the Family Tetrahymenidae and a Proposed New Genue and Species, <i>Paratetrahymena wassi</i> . J. C. Thompson	126

NO. 4, SEPTEMBER, 1963

Academy Information	142
Minutes and Abstracts of the Sections	160
List of Members	285

Printed in Bassett, Virginia
by the
Bassett Printing Corporation

THE ANNUAL SUBSCRIPTION RATE is \$3.00, and the cost of a single number, \$1.00. Reprints are available only if ordered when galley proof is returned. All orders except those involving exchanges should be addressed to Carl W. Allen, Virginia Polytechnic Institute, Blacksburg, Virginia. The University of Virginia Library has exclusive exchange arrangements, and communications relative to exchange should be addressed to The Librarian, Alderman Library, University of Virginia, Charlottesville, Virginia.

NOTICE TO CONTRIBUTORS

Contributions to the Journal should be addressed to Paul B. Siegel, Virginia Polytechnic Institute, Blacksburg, Virginia. If any preliminary notes have been published on the subject which is submitted a statement to that effect must accompany the manuscript.

Manuscripts must be submitted in triplicate, typewritten in double spacing on standard 8 1/2" x 11" paper, with at least a one inch margin on all sides. Manuscripts are limited to seven pages, with the proviso that if additional pages are desired, the author may obtain them at cost. The author may estimate the length of his paper by counting the total number of characters, including blank spaces, and dividing this by 3300. The result is the approximate number of printed pages in the Journal.

Division of the manuscript into subheadings must follow a consistent plan. It is desirable that a brief summary be included in all manuscripts.

Footnotes should be included in the body of the manuscript immediately following the reference, and set off by a dashed line above and below the footnote content. Footnotes should be numbered consecutively from the beginning to the end of the manuscript.

References should be arranged alphabetically according to author. Each reference should include the date, full title of the article, the name of the Journal, the volume and pages. For example: Harvie, L. E. and S. P. Maroney, Jr., 1961. Respiration and hemolysis of ultraviolet irradiated frog erythrocytes. *Va. Jour. Sci.* 12:1-9. References to the bibliographic citations should not be made by numbers. Instead, using the above citation, where a reference is desired: either (Harvie and Maroney, 1961) or Harvie and Maroney (1961).

Explanation of graphs and tabular material should be typed on separate pages. All figures should be numbered consecutively beginning with the first text figure and continuing through the plates. If figures are to be inserted in the text this should be indicated at the appropriate place in the margin.

Illustrations including lettering, should be arranged so that on reduction they will not exceed the dimensions of the maximum size of a printed page. Large plates must be accompanied by photographic copies which can be sent to the reviewers. The Journal will furnish the author with one plate or its equivalent; additional figures, colored illustrations or lithographs may be used only if the author makes a grant covering the cost of production. Original drawings (which must be done in black drawing ink) not photographs of drawings, should accompany the manuscript. When photographic prints are used they should be glossy, sharp and show good contrast. Drawings not neatly executed and labeled (do not use a typewriter), or which are not submitted on white paper will not be accepted.

Galley proofs are sent to the author for correction. Costs of excessive changes from the original manuscript must be defrayed by the author.

OFFICERS OF THE VIRGINIA ACADEMY OF SCIENCE

Jackson J. Taylor, *President*

Foley F. Smith, *President-Elect*

Paul M. Patterson, *Secretary*

Rodney C. Berry, Sr., *Treasurer*

William B. Wartman, *Assistant Secretary-Treasurer*

COUNCIL

P. A. Hansen

H. G. M. Jopson

G. T. Miller, Jr.

S. B. Row

P. B. Siegel

E. D. Brand

J. L. Calver

J. M. Grayson

S. B. Williams

R. D. Hughes

B. Harshbarger

Suzie V. Floyd

E. F. Turner, Jr.

H. Leidheiser, Jr.

W. W. Scott

768 6D XL 11114
08/24/95 198115 SELE

BI
10/24/95





SMITHSONIAN INSTITUTION LIBRARIES



3 9088 01379 9473